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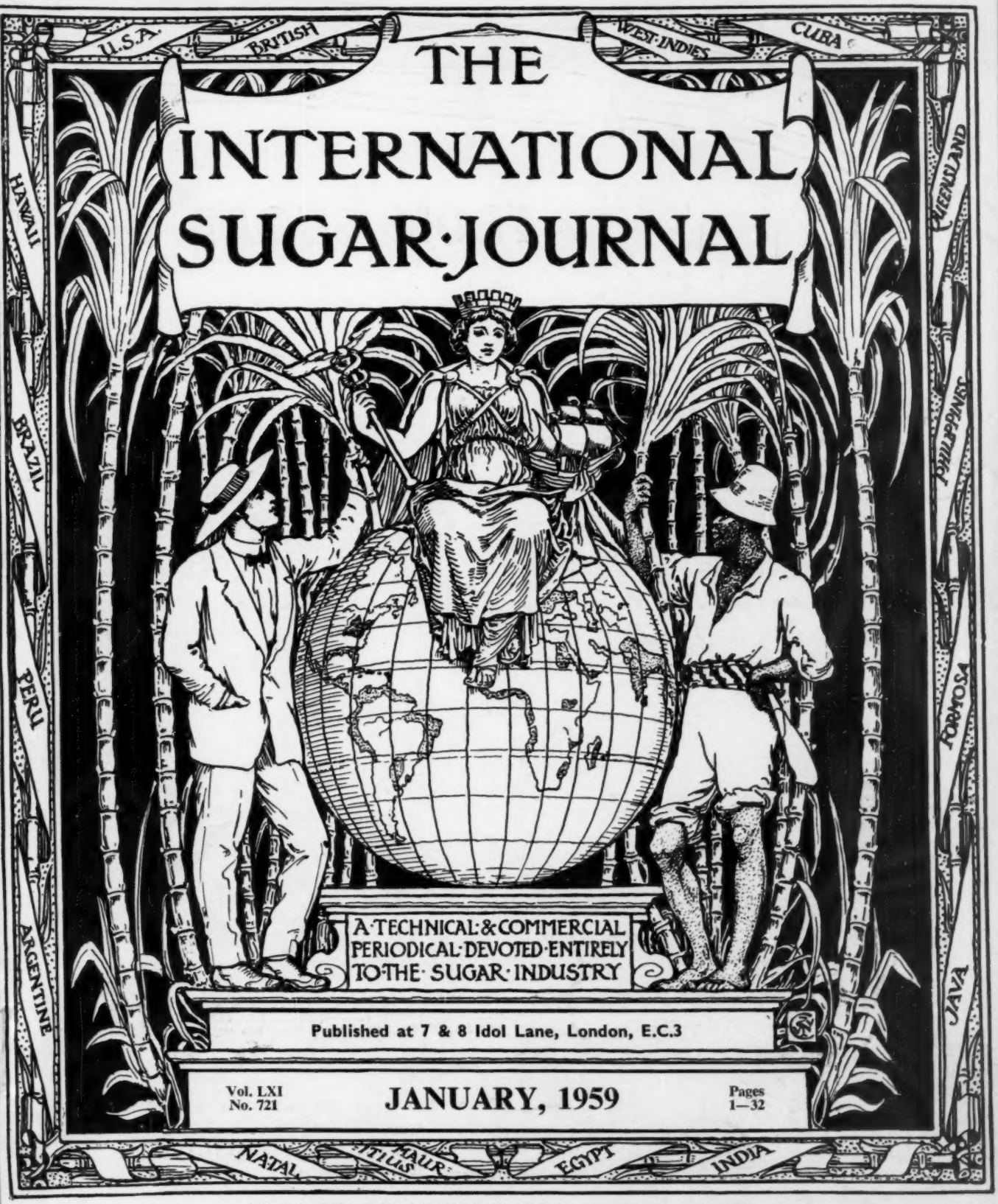
THE INTERNATIONAL SUGAR·JOURNAL



A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

Published at 7 & 8 Idol Lane, London, E.C.3

Vol. LXI
No. 721

JANUARY, 1959

Pages
1—32

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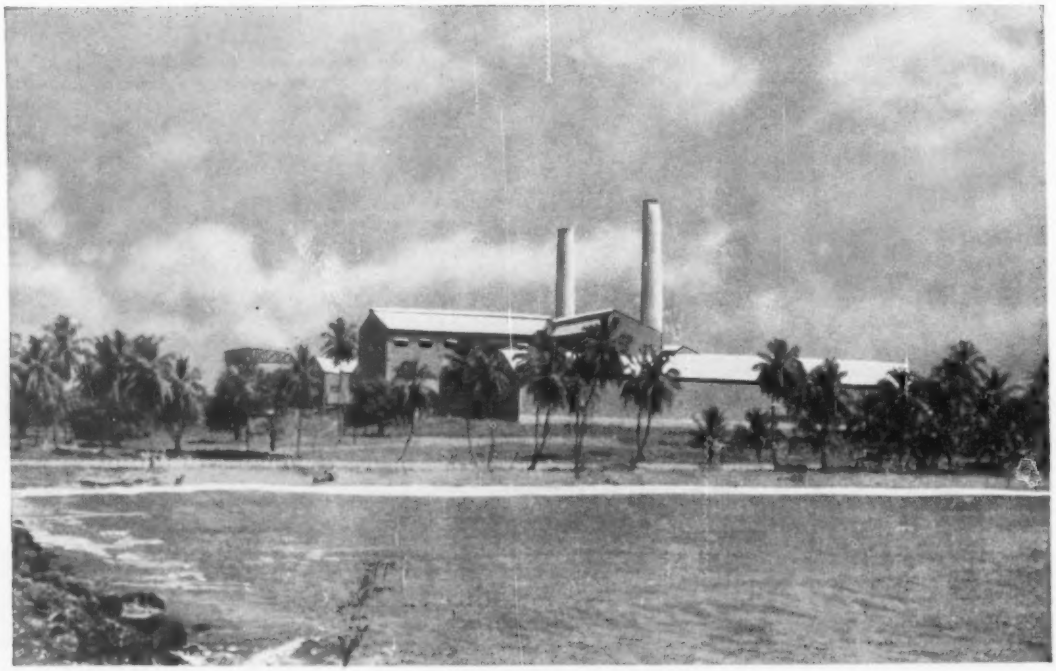
FROM SUGAR CANE

With 'Mirrlees'



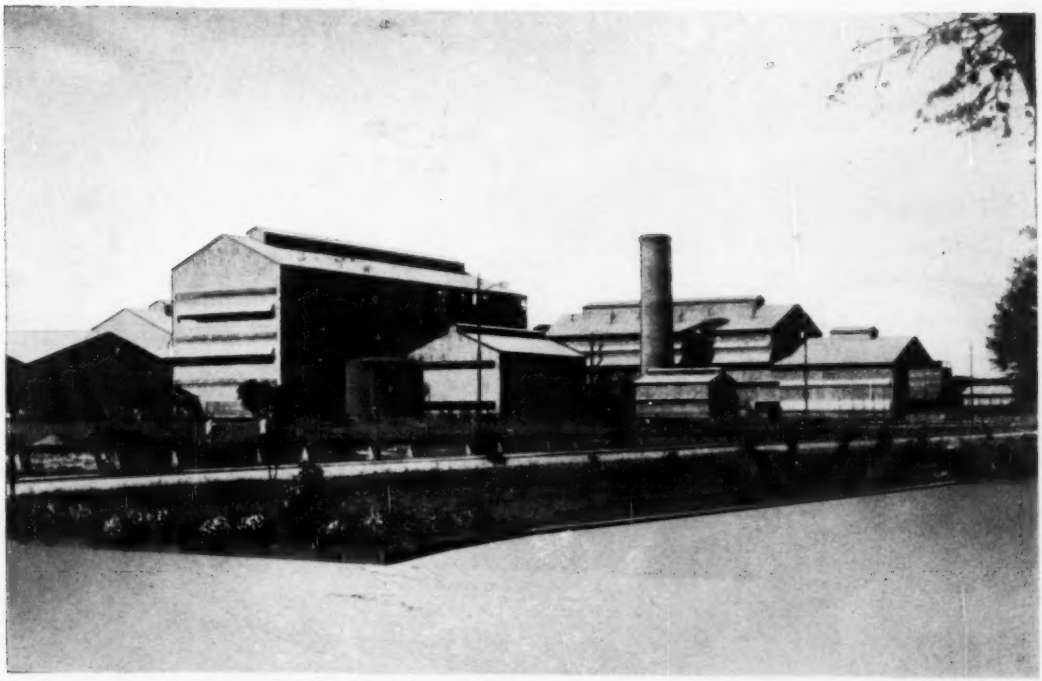
Central Rio Haina in the Dominican Republic selected Mirrlees equipment to increase capacity from 6,500 to 13,000 tons cane per day. Last crop they ground 1,205,016 tons. They produce raw sugar.

'Mirrlees'

We manufacture in our own works most of the equipment required in the production of Cane Sugar from Sugar Cane and welcome enquiries for particular items—or complete factories.

TO CANE SUGAR

Machinery



Central Rio Turbio in Venezuela installed Mirrlees equipment throughout. This factory grinds at the rate of 2,500 tons cane per day and produces refined sugar.

The MIRRLEES WATSON COMPANY LIMITED

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Belliss & Morcom Ltd

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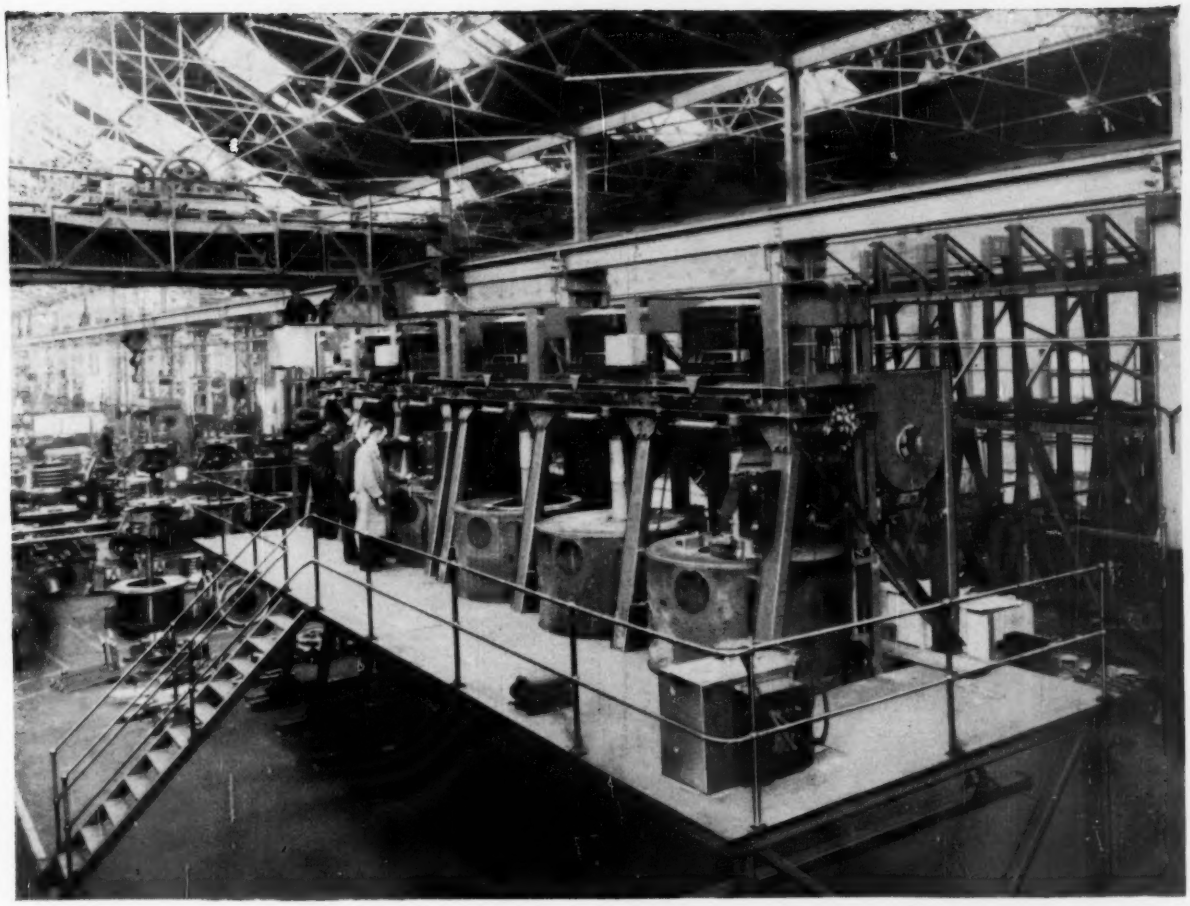

FOR MAURITIUS . . .

A battery of three 48″ x 1000 RPM and three 42″ x 1500 RPM centrifugals with automatic ploughs, completing running tests in the assembly bay before despatch to the Medine Sugar Estates Co. Ltd., for curing 'A' and 'B' massecuites; we are also supplying a battery of five 48″ x 1500 RPM centrifugals for low grade massecuites.

The framework in the background is for six 42″ x 1500 RPM centrifugals for British Guiana.

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The world's largest manufacturer concentrating entirely on industrial centrifugals

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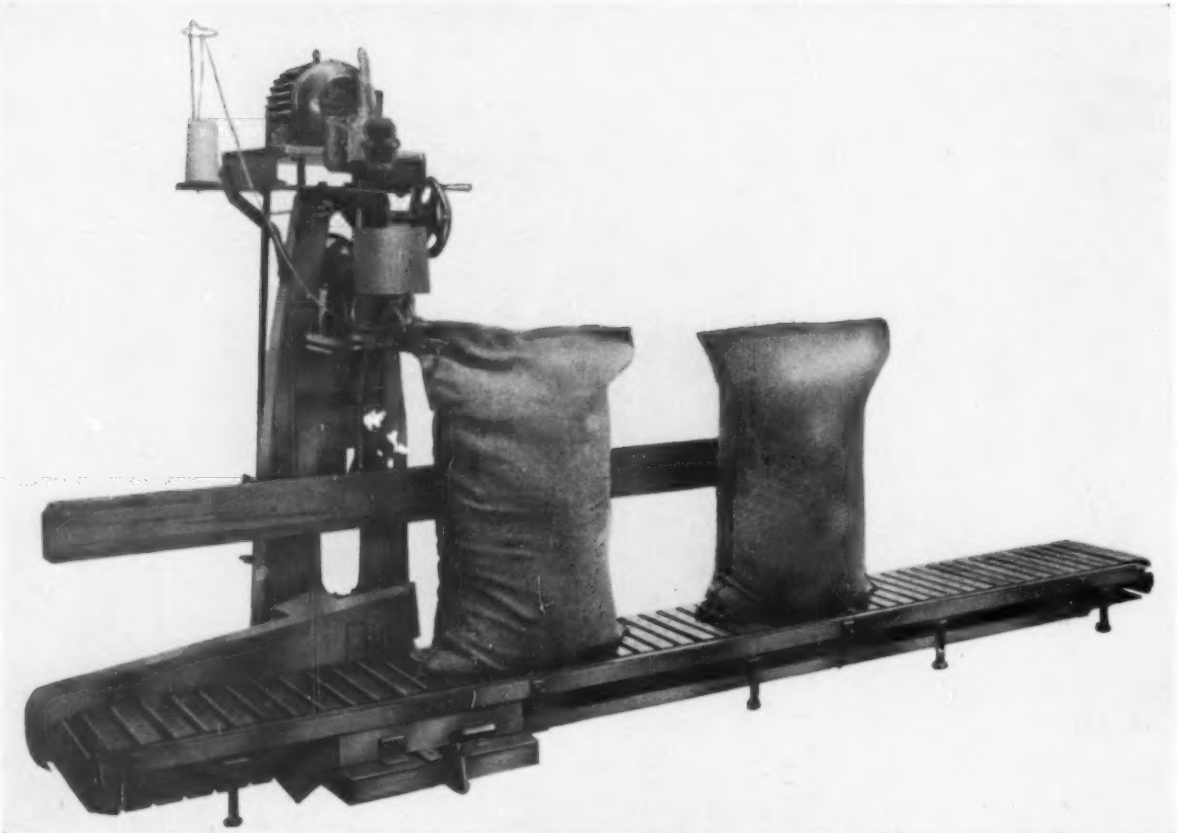
BI/7

The 'Super' Universal Sack Closing Machine

MODEL NO. 5B

Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive



This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.

Machines can be seen working by appointment.

Power required 2 h.p. *Shipping weight : 14 cwts.*

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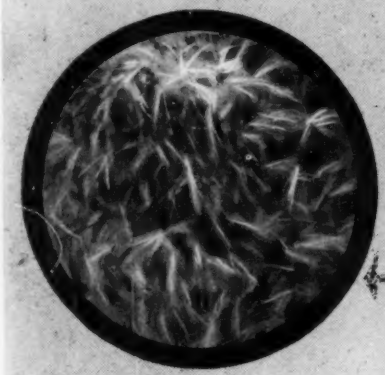
UNIFORM PREPARATION OF SUGAR CANE ASSURED THE WORLD OVER

The GRUENDLER Cane Shredding Process prepares any variety of cane so that maximum mill efficiency is achieved

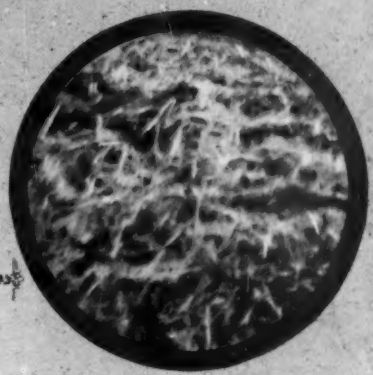
THE GRUENDLER-SHREDDED CANE SHOWN IN PHOTOGRAPHS BELOW IS FROM TWO HEMISPHERES: ONE IS FROM THE ORIENT, THE OTHER FROM THE WESTERN HEMISPHERE WHERE VERY HIGH FIBER AND HIGH TRASH CONTENT PREDOMINATE



With the Gruendler Process, mills have only one function to perform . . . to squeeze the juice out of the cane *without the added task of breaking the very hard joints and rind before extracting the juice.*

NOTE THE UNIFORMITY

Which is the Cane from The Western Hemisphere and which is from The Orient?*



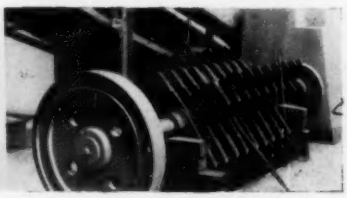


Photo shows one set of modern cane knives made unnecessary by the installation of the Gruendler Cane Shredding Process.

FUNDAMENTAL ADVANTAGES of the GRUENDLER PROCESS

- No additional mill stands required
- No high hydraulic pressures required
- Lower maceration (all juice-bearing cells ruptured)
- Higher sucrose extraction (percentage sucrose in cane)
- Mill maintenance greatly reduced

If you would like to know more about the application of the Gruendler Cane Shredding Process, write:

Gruendler

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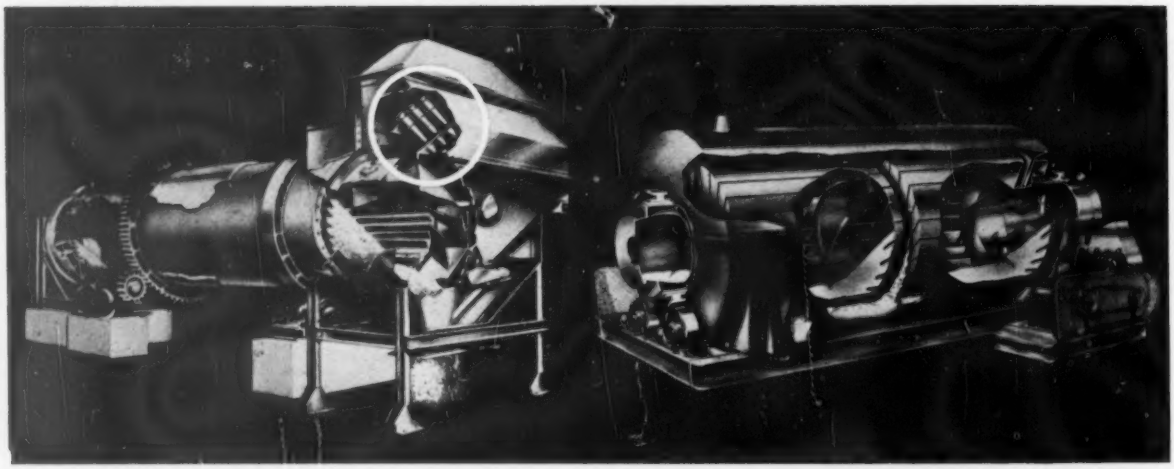
*Cane on the left is from the Orient, cane on the right from Western Hemisphere.

ROTARY LOUVRE....

Dryers
Roasters
Coolers

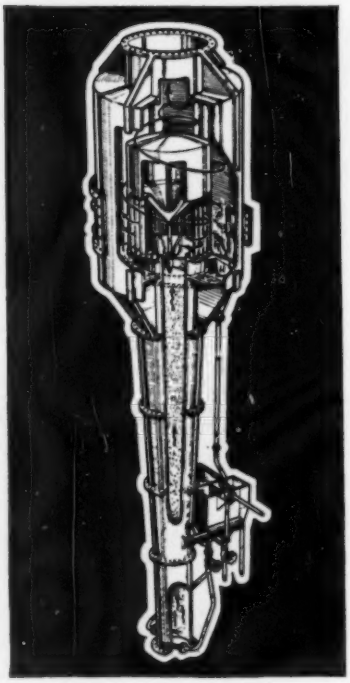


The well known Rotary Louvre Dryer

The new Rotary Water Louvre Cooler

A product is only as good as the equipment processing it. Our range of Dryers and Coolers is constructed to standards of precision and finish that ensure the highest degree of control, consistency and absolute reliability. Rotary Louvre equipment fulfils the requirements of Sugar Refineries when drying and cooling sugar either for filling into paper sacks or for bulk storage.

The latest addition to our range—the ROTARY WATER LOUVRE COOLER is of the staged and indirect type, using water as the coolant. The Dryers and Coolers are used by most of the biggest names in industry, and could make a major contribution to the efficiency of your plant.



THERMIX Dust Control & Collection Equipment for Sugar Refineries

The AIRMIX Wet De-duster illustrated is specially recommended for the collection of sugar dust created in the handling of sugar. Control of the dust as it is produced by positioning suction points and hoods on Elevators, Screens, Conveyors etc. enables it to be collected at a central point by an AIRMIX unit. Collection efficiencies of 99·8 per cent can be obtained, and the sugar solution in the washer is continuously recycled before passing to remelt.

The THERMIX range also includes TUBIX (Multi-tubular) Dust Collectors : BAG FILTERS : CYCLONES : DISCHARGE VALVES, etc.

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Illustration shows final stage of automatic process.

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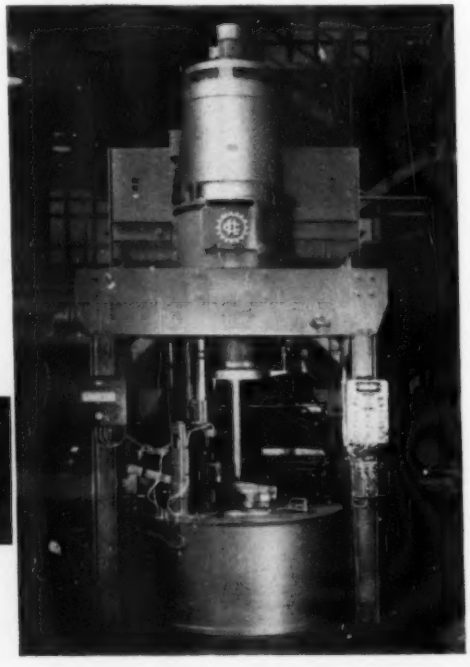
(1861) (1812)

the two oldest French sugar machinery manufacturers have united their powerful designing, research and production facilities.

FIVES LILLE-CAIL
is putting four works employing 10.000 people
at the service of the sugar industry

One of its achievements :
the FULLY AUTOMATIC CENTRIFUGAL
- *drive by Ward-Leonard system*
- *electronic control*
- *record production with massecuites of all grades*



Sté FIVES LILLE - CAIL
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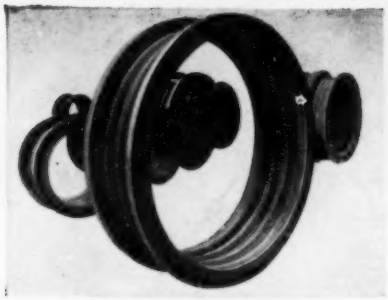

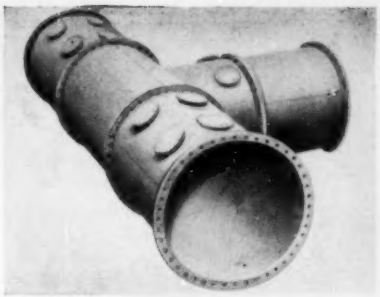

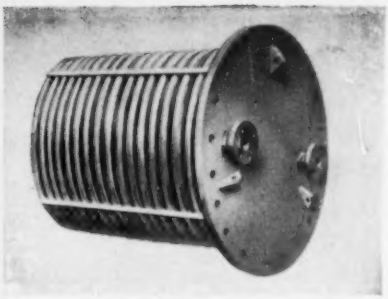

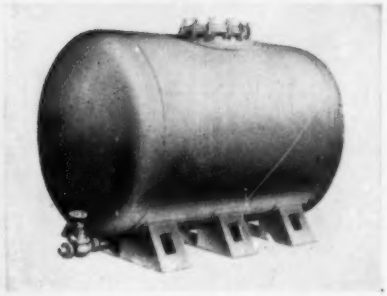

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- **Agents or representatives in all parts of the country**

Plate preparation bay—new Fabrication Shop

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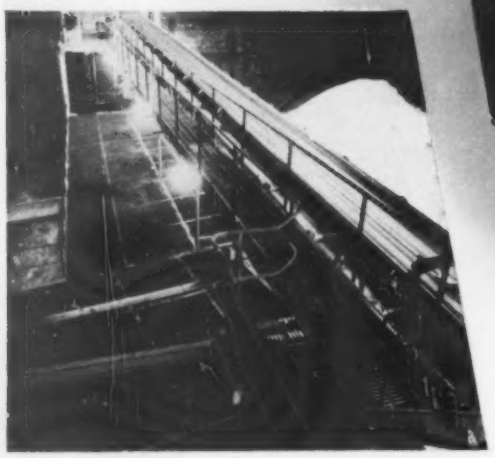
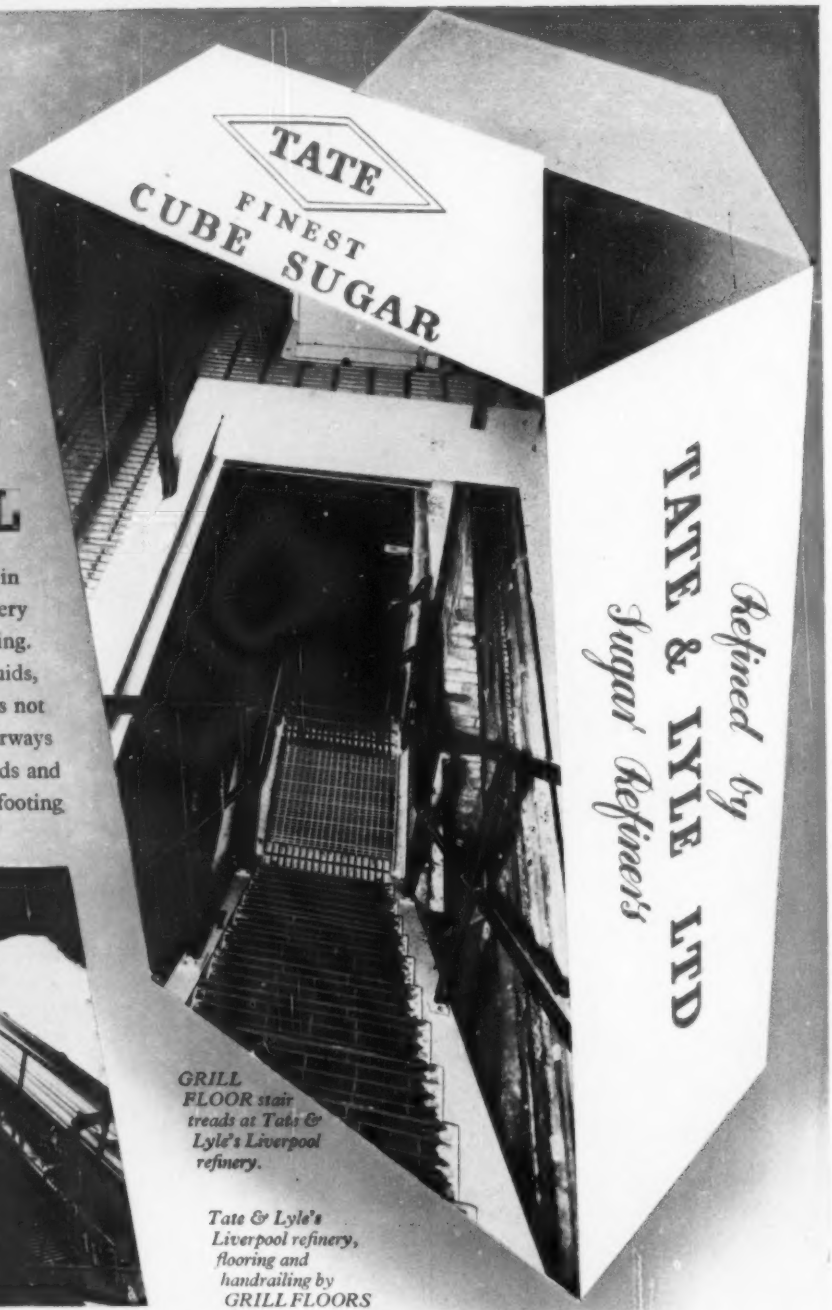
Safe foothold is assured in Tate & Lyle's Liverpool refinery by GRILL FLOOR flooring. Its open, non-slip surface sheds liquids, is easily cleaned and does not harbour dirt. On the stairways GRILL FLOOR stair treads and handrailing provide a sure footing





GRILL FLOOR stair treads at Tate & Lyle's Liverpool refinery.

Tate & Lyle's Liverpool refinery, flooring and handrailing by GRILL FLOORS

GRILL walkways

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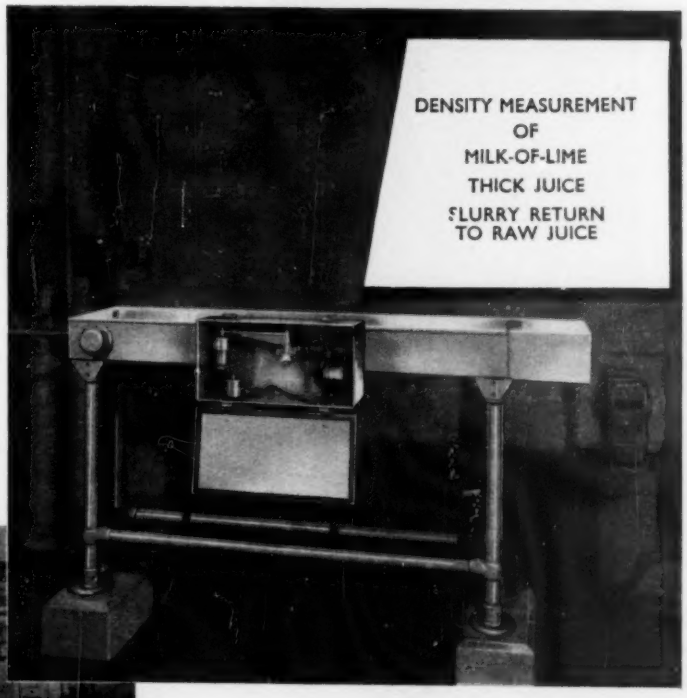
ROTAMETER

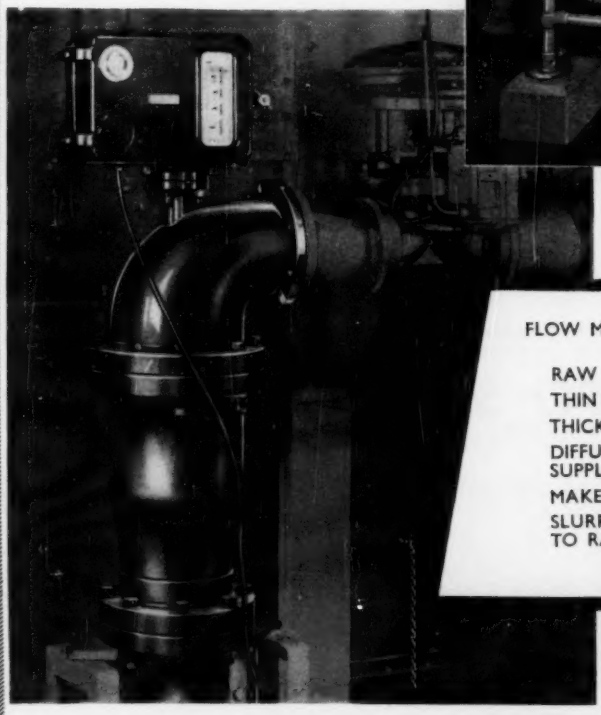
at WISSINGTON

Rotameter transmitting density meters and flowmeters are integrated into the Evershed and Vignoles electronic control system at the British Sugar Corporation sugar factory at Wissington.

These instruments are also available with pneumatic transmission.



DENSITY MEASUREMENT
OF
MILK-OF-LIME
THICK JUICE
SLURRY RETURN
TO RAW JUICE



FLOW MEASUREMENT
OF
RAW JUICE
THIN JUICE
THICK JUICE
DIFFUSION
SUPPLY WATER
MAKE-UP WATER
SLURRY RETURN
TO RAW JUICE

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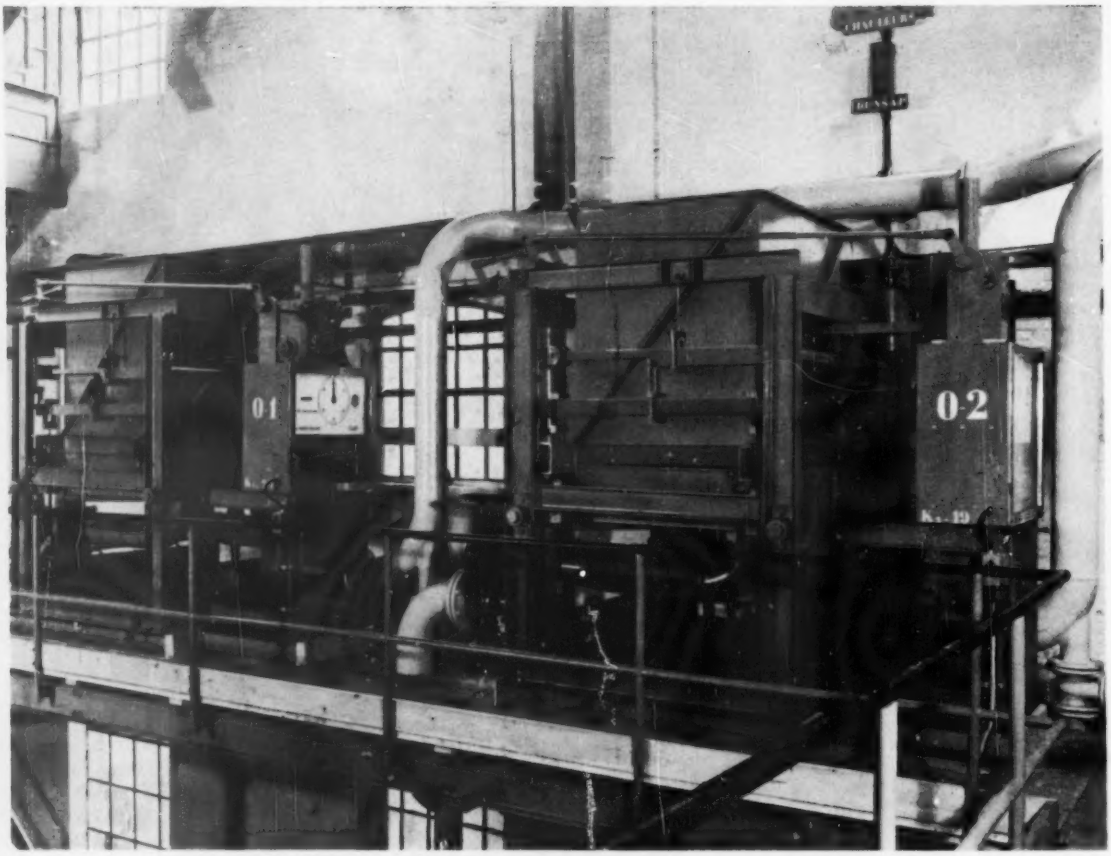


Two 60 t/h sugar juice Duplex weighers installed in a Dutch refinery

HAVE YOU A WEIGHING PROBLEM?

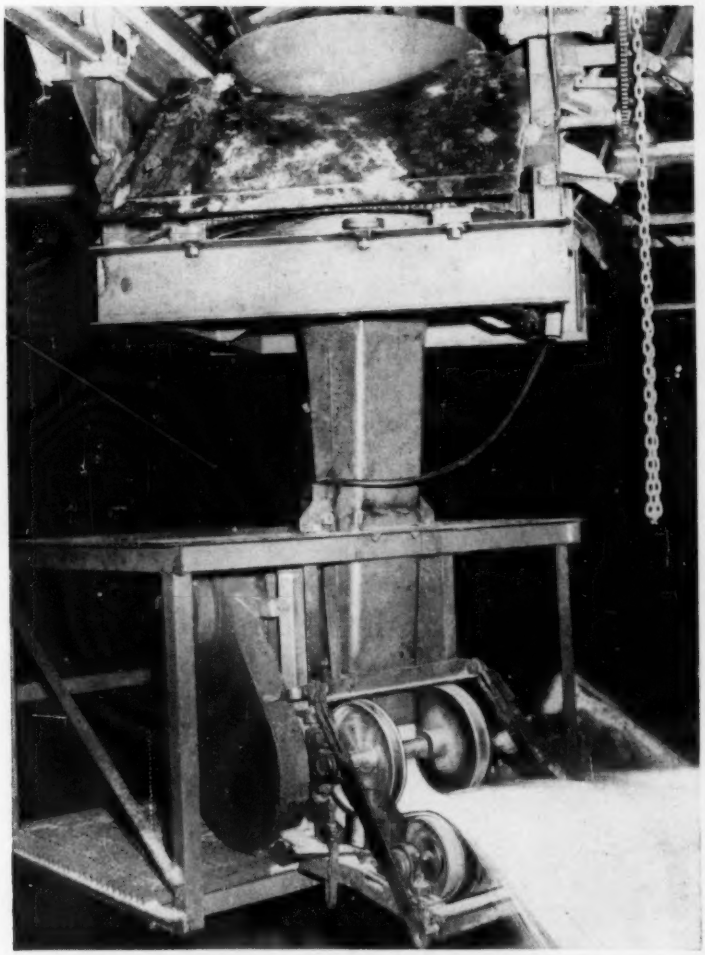
ASK US TO SOLVE IT

N.V. SERVO-BALANS

THE HAGUE HOLLAND

How LINK-BELT Jetslingers and conveyors coordinate

warehousing of 30,000 tons of raw sugar



JETSLINGER piles sugar throughout the vast storage area of this warehouse. Trolley-mounted, under Link-Belt transverse shuttle conveyor, this unit can rotate 360°. It is one of two Jetslingers cutting handling costs at this mill.

70 tons per hour move into storage at Fajardo Sugar Co.

This highly efficient handling system conveys raw sugar from centrifugals to scale hoppers for accurate weighing. It is then conveyed to storage by belt conveyors and to two Link-Belt Jetslingers. Portable belt conveyors are used for loading sugar into trucks. Link-Belt bucket elevators and screw conveyors are also a key part of this Puerto Rican installation.

Link-Belt offers a complete line of conveying and power transmission machinery for the sugar industry—designed to assure low per-ton handling costs. If desired, Link-Belt will design, equip and supervise erection of an entire sugar handling system . . . tailored exactly to your space and capacity requirements. For complete details, contact your Link-Belt representative. Or write direct.

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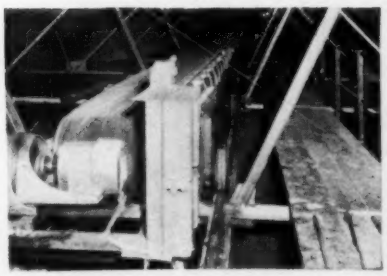
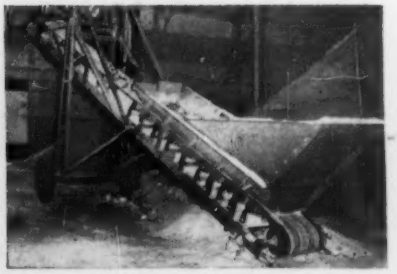
3 TYPES OF LINK-BELT CONVEYORS EMPLOYED AT CENTRAL FAJARDO MILL



REVERSIBLE SHUTTLE CONVEYOR operates in warehouse discharging sugar from either end to Link-Belt Jetslinger.

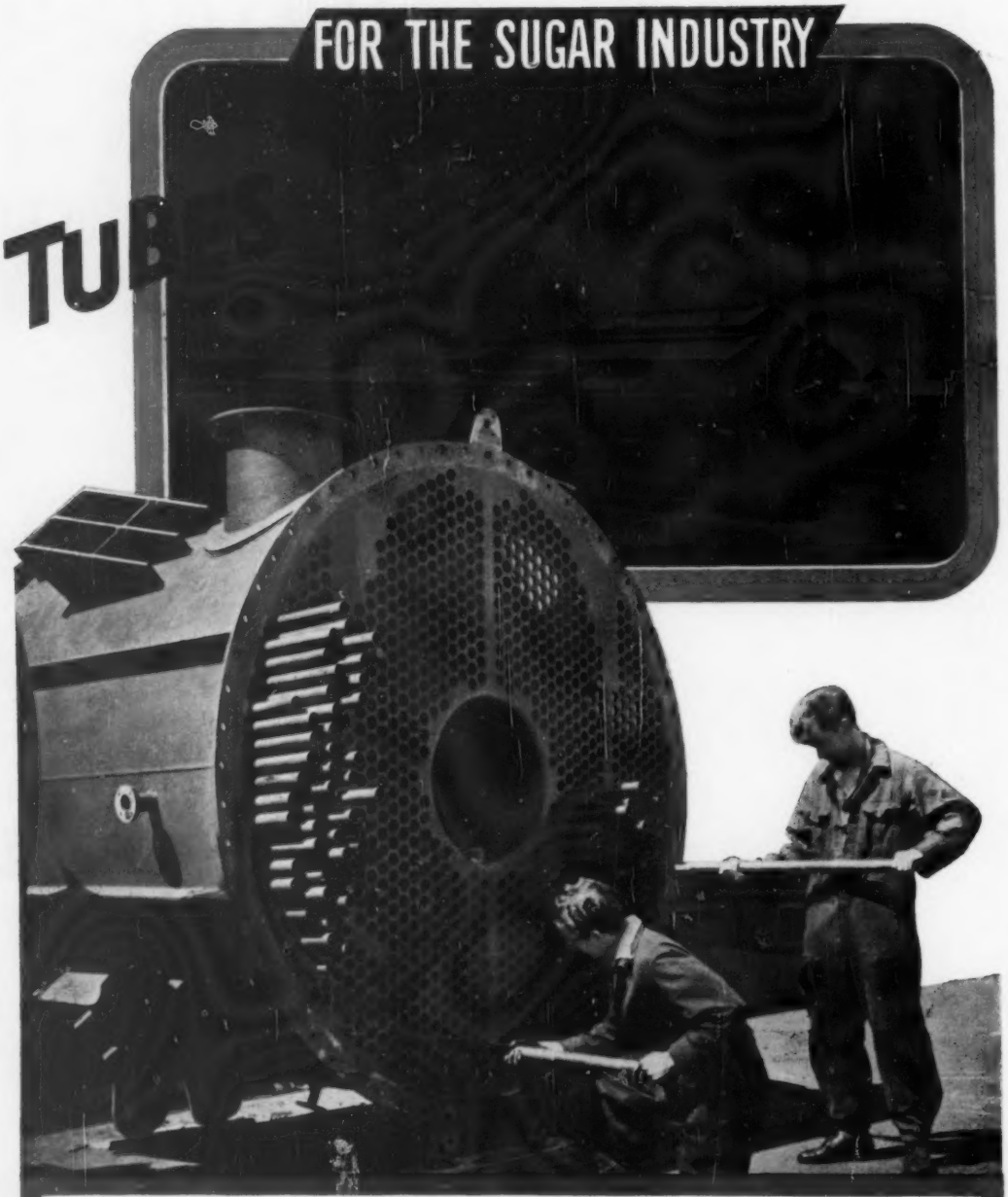
INCLINED BELT CONVEYORS handle sugar from scale hoppers and onto transfer belt conveyor for delivery to storage.



PORTABLE BELT CONVEYORS used for reclaiming sugar from storage pile for delivery into trucks.

TUBES OF QUALITY

FOR THE SUGAR INDUSTRY



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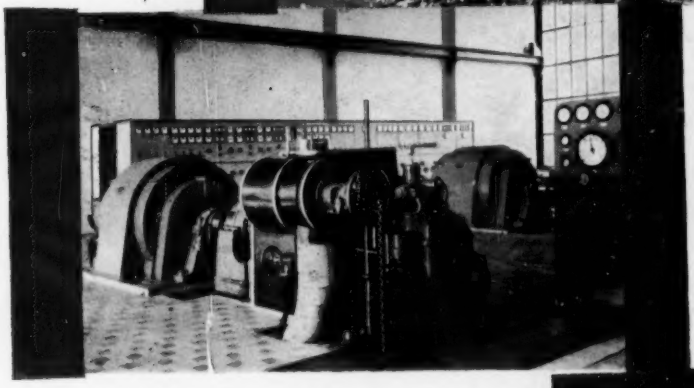
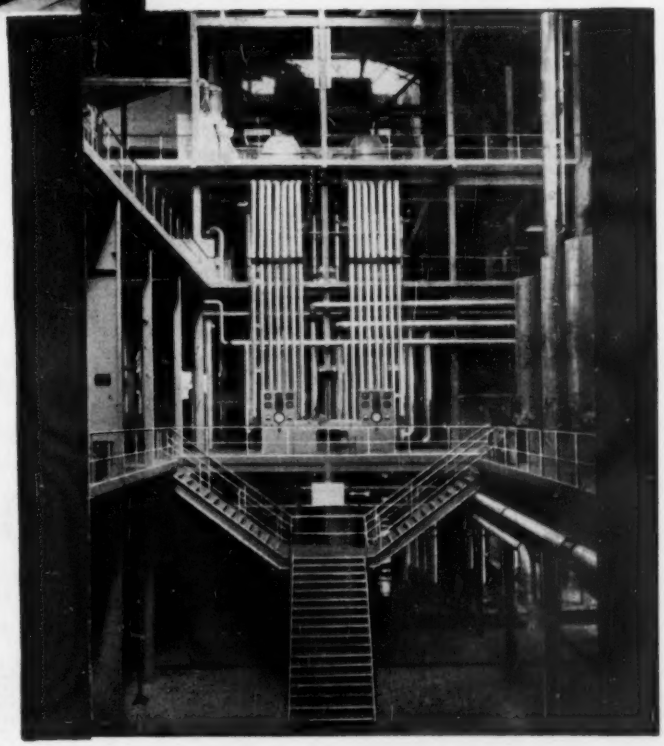
Glasgow Office: **50 WELLINGTON STREET**

TUBE MILLS and FOUNDRIES { **Grove Street** / **Halberton Street** / **Dugdale Street** } **BIRMINGHAM**



Profit from our experience



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PERFORMANCE
ECONOMY
EFFICIENCY

Our sugar programme during the last 4 years

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(in a working combine with other specialized firms)

4 Sugar factories in Turkey

1 Sugar factory in Iraq *with annexed Refinery*

4 Sugar factories in India

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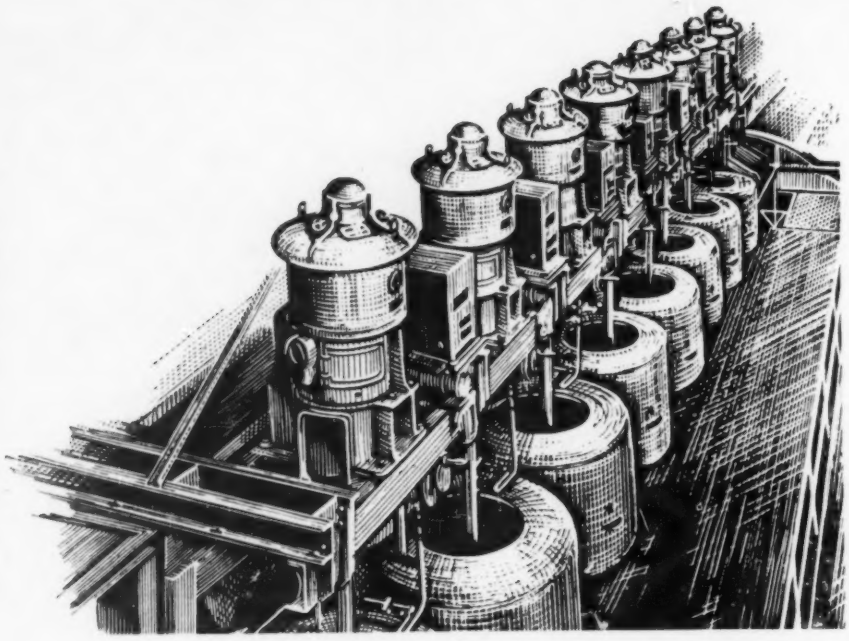

Complete machinery equipment for beet or cane processing.

More than 500 sugar mills in various countries outfitted.

We can deliver also equipment for alcohol production.

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Foreign Trade Corporation for Export of Complete Industrial Plants

Prague II, Václavské nám. 56, Czechoslovakia

I.S.J.

SUGAR BOOK DEPARTMENT

All books reviewed in this *Journal* may be obtained through our Sugar Book Department. Where no inclusive price is quoted in our review, 2s. 6d. should be added to cover the cost of packing and postage.

★ *Check your personal library against the list of basic books given below :*

		POST PAID
PRINCIPLES OF CANE SUGAR MANUFACTURE : *Davies*	(1938)	**22s. 6d.**
CANE SUGAR AND ITS MANUFACTURE : *Geerligs* ...	(1924)	**32s. 6d.**
CANE SUGAR HANDBOOK (8th ed.) : *Spencer and Meade*	(1945)	**134s. 6d.**
SUGAR ANALYSIS (3rd ed.) : *Browne and Zerban*	(1941)	**183s. 6d.**
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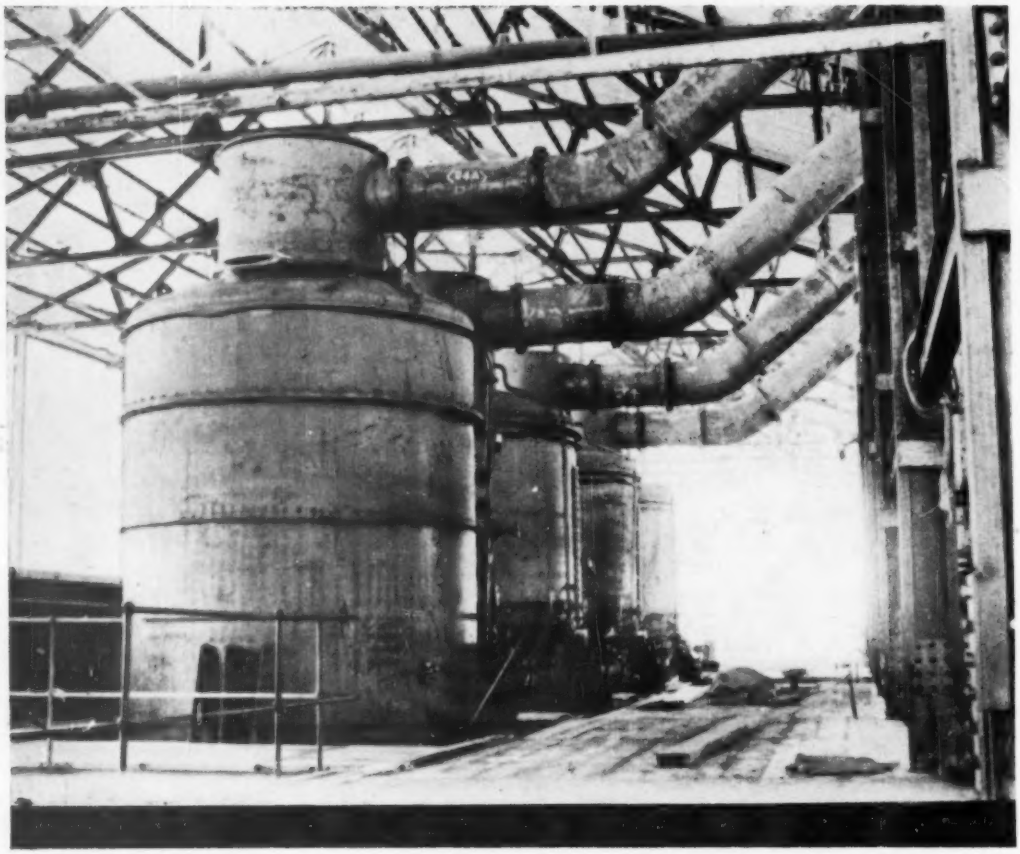

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THE
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VOL. LXI JANUARY, 1959 No. 721

NOTES AND COMMENTS

World Free Market and the Cuban Political Situation.

After a considerable time during which the Free Market raw sugar price remained fairly stable, disquieting news from Cuba influenced the market during the first part of December, causing the world spot price to rise by 26 points to 3·72 cents, a level not reached since January 1958. A report in the *New York Times* quoted a Cuban planter as saying that, "Castro forces control access to 12 of the country's 23 sugar ports, normally accounting for 32% of all sugar exports". In seven other ports sugar delivery is expected to be curtailed by 50% or more. The rebels have overrun the Province of Oriente, interfering with highway and rail communications. The suspension of constitutional guarantees which was to end on the 13th December 1958 has been extended for a further 45 days and the Cuban House of Representatives has approved the Government request for the declaration of a State of Emergency. The Senate is expected to approve this measure which gives the Government powers to increase the armed forces and to adopt measures to protect commerce and industry and to regulate communications.

* * *

Hawaiian Sugar Planters' Association, 78th Annual Meeting.

Lawrence Myers, Director, Sugar Division, U.S. Department of Agriculture, told members of the Hawaiian Sugar Planters' Association, attending the 78th annual meeting in Honolulu on 2nd December, 1958, "It would seem as though our domestic producers would be justified in proceeding with a greater degree of confidence in the substantial stability of the world sugar market as a result of the new (International Sugar) agreement".

Mr. Myers praised the cooperation of all countries at the recent Geneva conferences, where he represented the U.S. He discussed technical features of the International Sugar Agreement but said, "The greatest benefits in my opinion will come from the forum it provides for the study and discussion of international sugar problems and from the statistical and informational services which will now be developed under it".

The U.S. sugar authority congratulated Hawaii on their research work. However, output per man-day was termed the Islands' greatest achievement.

Mr. Myers stated that he knew of no proposals for changing the basic concept of U.S. Sugar Act, which expires at the end of 1960. "Our sugar legislation has been of great benefit to domestic and foreign suppliers for nearly a quarter of a century. Also, it has proved helpful in protecting domestic consumers against shortages and excessive prices during periods of emergencies. It seems reasonable to suppose, therefore, that Congress will continue to extend the Sugar Act so long as it appears to be in the national interest and of benefit to consumers and producers", concluded Mr. Myers.

Boyd MacNaughton, H.S.P.A. president, told the meeting that production for 1958 is estimated at 783,000 tons and for 1959 at 1,100,000 tons. The latter is far above previous estimates. He spent considerable time calling attention to the need for vigorous support of action directed toward the stabilization of the sugar industry's union relations and commented, "There can be little optimism over the future of our sugar-producing enterprises unless we can face these union relations squarely and, within a dangerously short space of time, arrive at workable, satisfactory solutions".

Slator M. Miller, H.S.P.A. vice president, reported on recent 1959 estimate of consumption hearings held in Washington, on changes in Sugar Inc. organisations and touched on coming Sugar Act legislation.

Donald Maclean, president of California & Hawaiian Sugar Refining Corp. of San Francisco—the wholly owned marketing and refining organisation of the Hawaiian industry—reported total refined deliveries for 1958 were expected to be 685,000 tons. This is approximately 100,000 tons less than the initial estimate.

Mr. Maclean said, "While it is true that we will probably have a deficit (for the industry based on government quota) in 1960, there is comfort in knowing that the estimates for 1961 to 1965 . . . indicate that Hawaii will, for all practical purposes, make its quota from 1961 to 1965". (Hawaii will meet the

1959 quota if production is as much as 1,100,000 tons, due to carryover of 50,000 tons from 1958.)

"In the years 1955, 1956, and 1957 the Hawaiian sugar industry absorbed an average of $1.5 million above the freight cost to San Francisco on raws (raw sugar) shipped east. Absorption on refined sugars to inland markets over these same three years has averaged in excess of $3 million a year", he said.

A. G. Budge, president of Castle & Cooke, is H.S.P.A. president for 1958–1959, while S. L. Platt was re-elected secretary.

* * *

Sugar in East Africa, 1957.[1]

Sugar production was, once again, a record in all three Territories—Kenya, Uganda and Tanganyika—while the trend of consumption, rising in recent years, was reversed with a 2% decrease. Production on the Tanganyika Planting Co.'s estate at Moshi continued to expand. Factory capacity was increased in 1956 and output has gone up from some 10,000 tons (average 1952/55) to 18,000 tons in 1956 and 19,453 tons in 1957 with a prospect of 25,000 tons in 1958. The Kilombero Valley is being investigated for sugar production by the Tanganyika Sugar Co. Ltd., as previously announced[2]. Miwani factory in Kenya increased production to 17,502 tons in 1957, while at Ramisi output was 3320 tons of sugar.

Cane growing for production of jaggery for local consumption is increasing generally, and in the Nyanza area of Kenya alone, the total area under cane for jaggery now amounts to 23,000, with a cane production in 1957 of 252,054 tons. New jaggery factories are under construction and additional factories are planned.

Production in Uganda, at over 80,000 tons, exceeded the previous year's record by 11,000 tons and gave a 20,000-ton surplus for supply to Kenya and Tanganyika. The two main estates, Kakira and Lugazi, with a total acreage of just over 30,000, now employ about 18,000 people. New machinery has recently been installed at Lugazi which will increase the capacity of this factory considerably.

East African import requirements during 1957 were substantially below the previous year at some 48,000 tons. A contract was signed in November 1957 for the supply of 30,000 tons of British refined sugar during 1958 and it is expected that this will cover all East African requirements for the whole of 1958 and possibly the early part of 1959.

* * *

Commonwealth Sugar Agreement.

The Ministry of Agriculture, Fisheries and Food announced on 4th December, 1958, that the series of meetings with representatives of the Commonwealth sugar exporting territories which began on 11th November has now been concluded. Discussions have taken place on the negotiated price for 1959 under the terms of the Commonwealth Sugar Agreement and on other matters arising under the Agreement.

Full agreement has been reached as follows :—

(1) *Price for* 1959.

The negotiated price for 1959 will be £45 2s 0d per ton. (£43 16s 8d in 1958).

(2) *Duration of the Commonwealth Sugar Agreement.*

The Agreement has been extended for a further year and now runs to the end of 1966.

(3) *Quotas.*

Negotiated price quotas for the year 1959 will be increased by 2½% above those for 1958. Overall agreement quotas remain unchanged.

The position of British Honduras, St. Vincent and East Africa in relation to the Agreement will be reviewed at the time of the annual negotiations in November, 1959.

Under Chapter VII of the Agreement the position of these territories under the Commonwealth Sugar Agreement was to have been determined at a quota review in 1953, but has so far been deferred by general agreement.

(4) *Price Fixing Arrangements.*

The parties to the Agreement will consider together in 1959, as in 1955, the working of the system by which the negotiated price is determined.

The rise in negotiated price quotas for 1959 is made under Article 15 of the Commonwealth Sugar Agreement which provides for such increases when United Kingdom consumption of sugar exceeds 2,550,000 tons. The effect of these increases, which total about 39,000 tons, will be as follows :

	Existing Annual Negotiated Price Quota	*Addition for 1959*
	tons	tons
Australia	300,000	7,500
West Indies and British Guiana	640,000	16,000
British Honduras	3,600*	90*
Fiji	120,000	3,000
Mauritius	335,000	8,375
St. Vincent	1,050	26
South Africa	150,000	3,750

*The arrangements made last year to enable British Honduras as production expands to increase exports within her maximum quota under the Agreement will be continued in 1959.

The Late Sir William Rook.—The Chairman of C. Czarnikow Ltd., Sir William Rook, died on the 29th November at the age of 72. He was called to the Ministry of Food at the beginning of World War II as Deputy Director of Sugar, becoming Director in 1941 and serving in this position until 1950.

[1] East Africa 1957. (East African Office, London). 1958. Price : 5s. 0d.

[2] *I.S.J.*, 1958, **60**, 119.

DISCREPANCY BETWEEN SCIENTIFIC DISCOVERY AND PRACTICE

By Dr. WILLIAM E. CROSS.

PART I.

MUCH has been said and written about the great need, in the sugar industries of many countries, for more systematic, scientific research, designed to discover superior and more suitable varieties of cane, better and more economical methods of cultivation, fertilization, irrigation, etc., more efficient methods of manufacture, and more complete utilization of the by-products; and there is no doubt that very much benefit should accrue from such investigations. But although I fully recognize the potential value of new scientific discoveries, in my many years of work in the sugar industry it has been borne upon me more and more that there is another very important benefit, more readily and immediately available, which could be obtained by many sugar enterprises, and that is by simply putting into practice the knowledge which has already been discovered, including some which has been known for many years.

In this respect I would remark how very few sugar concerns have a well stocked technical library of the standard text books and the periodical technical literature, by means of which their staff could keep itself abreast of the progress made in the industry in different countries, in its various aspects, as well as continually refresh its knowledge of the scientific and technical side of their work, especially in its relation to the solving of the problems which frequently present themselves. Yet such a library would cost, to start up, and to maintain from year to year, a sum which for any sugar enterprise would be entirely insignificant. I may say that the fact that such libraries do not exist in the factories is not due to any lack of recommendations on the subject, which have been legion—it is rather a matter of incomprehension.

In this article I will just mention a few cases of well proven knowledge, which is not taken advantage of by many sugar concerns. Well known, for instance, is the extreme danger of introducing new diseases and pests into a country, if cane cuttings are imported and planted without having been thoroughly examined by experts, and without having been grown in quarantine for a prolonged period—and indeed this is definitely prohibited by law in most if not all cane countries. Yet I have known many cases in which growers, factory owners, or managers, and even technical men, have smuggled in, and planted, such cuttings—often bringing them in a suit-case on their return from a trip abroad.

Equally well known are the great advantages of practising rotation with leguminous crops in the cultivation of the sugar cane, especially in sanitation of the soil, eliminating pernicious weeds and also the toxic substances and the pathogenic organisms which have accumulated during the years under cane, in improving the physical condition of the soil and increasing its capacity to retain humidity, and in increasing its content of humus and fertilizing elements, especially nitrogen—but nevertheless, in the majority of cane countries, this practice is not employed. As F. S. EARLE says[1] : "Unquestionably, a crop of legumes should be grown whenever a field on old cane lands is plowed up for replanting. This, however, occurs so infrequently in most cane-growing countries that green manuring can only be a minor factor in maintaining soil fertility". In the Argentine, at one time, we succeeded in persuading many of the *ingenios* to practise rotation with a specially luxuriant variety of cow pea which we produced in the Experiment Station, but they afterwards gave it up, so much so that nowadays it is impossible to buy cow pea seed of a suitable variety in the whole country.

It is also generally recognized that cane lands should have adequate drainage, as this keeps the soil in a favourable condition for the plants and the beneficial micro-organisms growing in it, assuring proper aeration, increasing the depth to which the roots may extend, enabling the soil to heat up quicker, especially in the spring, and preventing the accumulation of alkali. Many authorities have insisted on this need. For instance A. H. ROSENFELD[2] states that "Drainage occupies a position of the most vital importance in any consideration of sugar cane agriculture . . . No phase of plantation activity requires greater experience and general aptitude from the field men". Also A. C. BARNES[3] says that "While ample water is needed, a well-drained soil is essential". And, to cite one more opinion, F. S. EARLE[4] states that "On level lands with a close, impermeable subsoil, proper drainage becomes a question of overwhelming importance".

Nevertheless, in the majority of cane countries the need of drainage is frequently given insufficient or even scant attention. As BARNES says,[5] "Few, if any, irrigated lands need no drainage, and often the land and the crop suffer from the effects of inadequate drainage". And then again, EARLE[6] states "In only too many cases improper and insufficient drainage is a seriously limiting factor in production . . . On irrigated lands careful attention to drainage is particularly needed . . . Untold thousands of acres of the

[1] "Sugar Cane and its Culture", (Wiley, New York), 1928. p. 237.
[2] "Sugar Cane around the world", (Univ. Chicago Press), 1955. p. 350.
[3] "Agriculture of the Sugar Cane", (Leonard Hill, London), 1953. p. 66.
[4] *loc. cit.*, p. 229.
[5] *loc. cit.*, p. 70.
[6] *loc. cit.*, pp. 229, 231.

best irrigated cane lands have been ruined in this way by careless excess in irrigation, with no proper provision for prompt drainage of the low spots". And we have read recently[7] that even in Louisiana, where the high annual rainfall makes drainage the usual practice, "One of the major causes of low yields is the faulty grading and drainage of the land, leading to ponded areas with poor growth".

In the Argentine very little attention is paid to the need for drainage, so that many irrigated lands tend to accumulate alkali more and more, and even in some non-irrigated lands considerable losses occur through lack of drainage in years of heavy rainfall.

A very great deal has been written about the grave dangers of erosion in causing the impoverishment of the soil, and the means which should be taken to prevent it. In spite of this, however, serious damage to soils seems to be produced every year in most if not all cane producing countries. This can be seen from the many articles on the subject which have been published in this journal during the past few years, for example on erosion in America[8], the Philippines[9], Natal,[10] Australia[11], and Hawaii[12]—which would indicate that at least a good proportion of the cane growers are not putting into practice the necessary measures to avoid this damage. And in the Argentine we consider the harm produced by erosion each year to be very considerable, especially in the sloping and hill lands, as many growers even resist making their cane rows follow the contour of the land, and indeed in many cases they make them run straight down the slope, so that when it rains each middle becomes a rivulet which carries away a large proportion of the fertile soil. In this way many newly cleared, virgin lands have become non-productive in the course of a very few years.

Seeing that in all cane countries there is a considerable difference in the conditions of soil, climate, etc., between the different estates, the varieties of cane cultivated in each one of these should be those which have been definitely shown to be particularly adapted to its special conditions. This is the policy followed in Hawaii, and it is said to be one of the principal reasons for the very heavy yields obtained in those islands[13]. But in many other countries very little careful effort is made to find the best variety for each property, or even for each micro-zone. In most cases no careful statistics are kept each year on the total yields of cane and sugar produced in the different fields of each variety, on which to base the selection of canes for the new plantings, so that this is made on the basis of a vague "general opinon" that has been formed on each one. New varieties are planted and multiplied without any real attempt being made to determine quantitatively whether, under the conditions of each estate, they are better than, or even as good as, the older standard varieties. Even in countries where the fields are replanted after only one or two years of stubble, this empiric procedure is often costly, but where the cane is cultivated for many stubble years, as in the Argentine, for example, the possibility it entails of varieties being planted which are not the best for the local conditions may lead to serious losses.

One of the basic principles of all agriculture is that the seeds, or cuttings, to be used for planting should be submitted to a most rigorous selection, and in the plantation of sugar cane particularly this is especially imperative[14]. The fields from which the seed cane has to be cut should be those where the cane is most vigorous, well-developed, healthy, and most free from disease and insect pests ; and the cane itself, after cutting, should be submitted to a second, rigorous selection, stalk by stalk, in which will be chosen for planting only the best developed canes—with perfectly sound buds—which are the most free from disease, and insect pests like the borer, mealy bug, etc.

The great advantage of planting only cane which has been scrupulously selected in this way is enhanced by the fact that the cane, once planted, continues to produce crops during a number of years—which in many countries extends to six and even more—so that any deficiency in the seed cane, leading to poor germination, with gaps in the rows, and to the production of unhealthy, pest-infested cane, would turn out to be very expensive.

Nevertheless, this careful selection of the seed cane used in planting is hardly ever carried out in practice, except perhaps in Java and one or two other countries. On the contrary, the cane employed is frequently that from old stubbles, or from fields chosen for their proximity to those to be planted, and is cut, transported, and put in the ground without any inspection whatever.

Then again, scientific investigation has shown, as also has practical experience, that the application of nitrogenous fertilizers to the cane, while increasing the tonnage produced, at the same time tends to delay ripening and to reduce the factory yield at the time of the harvest—and that this effect cannot be avoided, or even diminished, by applying also phosphoric acid or potash fertilizers[15]. This fact signifies that cane should only be fertilized with a nitrogenous manure if it can be shown that the cost of the fertilizer and its application is definitely less than the *net* value of the additional *sugar* obtained, i.e., the gross value, minus the cost of the harvest, transport, and manufacture of the additional cane. To this end, in the middle of each field a few rows of cane should be left without fertilizing, to serve as "check", so that the respective yields can be

[7] *I.S.J.*, 1956, **58**, 262.
[8] *I.S.J.*, 1940, **42**, 124.
[9] *I.S.J.*, 1936, **38**, 50.
[10] *I.S.J.*, 1943, **45**, 4.
[11] *I.S.J.*, 1942, **44**, 33, and 1948, **50**, 36.
[12] *I.S.J.*, 1951, **53**, 303.
[13] G. KLINGE ; "Notas sobre la industria azucarera del Hawaii", *Bol. Soc. Nac. Agraria* (Perú), 1928, 81.
[14] W. E. CROSS ; "La selección de la caña para plantar", *Rev. Ind. Agric. Tucumán*, 1923, **14**, 61–66.
[15] W. E. CROSS ; *I.S.J.*, 1933, **35**, 96–101 ; also C. VAN DILLEWIJN, "Botany of Sugar Cane", 1952, 215–6, 243 ; A. H. ROSENFELD, "Sugar Cane around the World", 1955, 208–213 ; S. S. GARRUCHO, *I.S.J.*, 1957, **59**, 332.

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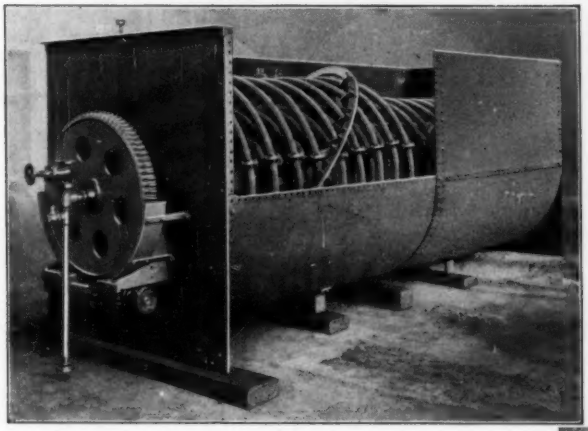

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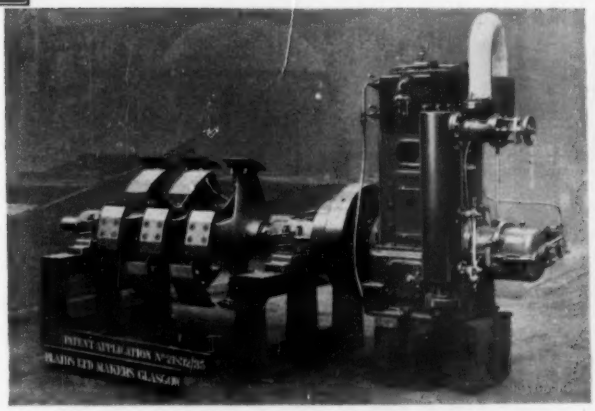

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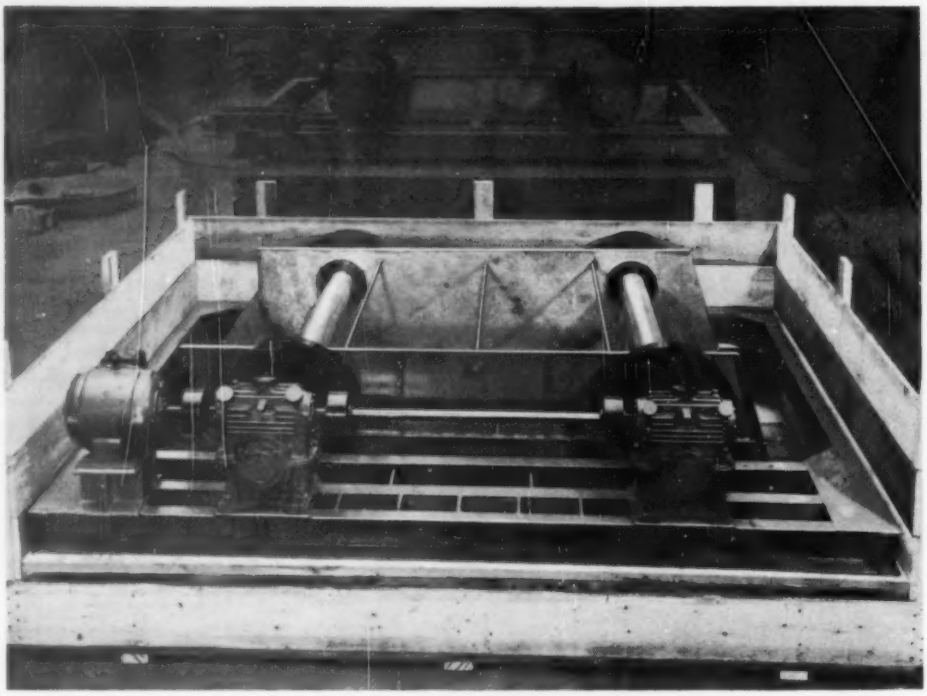

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determined, and the proper calculations made. But in most cane countries such verifications are hardly every made, and generally the effect of the fertilizers is judged solely on the general appearance of the cane, and the tonnage produced.

Furthermore, in sub-tropical countries, which have a short growing period, in order to reduce to a minimum the lowering of factory yields produced by nitrogenous fertilizers, these should be applied at the very beginning of the growing season. In very many cases this is just not done, but as none of the cane is left unfertilized, as a "check", the depressing effect of the manuring does not come to light.

In the United States the quality and analysis of all fertilizers sold is rigorously controlled by Government agencies, but as this is not the case in most other cane countries this control should be exercised in the laboratory of each factory. I have found that this is only done very rarely : almost always the analysis declared by the vendor is taken as being beyond suspicion.

In the harvest it is advisable to determine periodically the degree of ripeness attained by the cane of the different fields, and to cut them strictly in the order of their ripening. To this end periodic analyses should be made of samples from the different fields, and the rhythm of the ripening process established for each one. In many estates this is not done, and the order of cutting the fields is based upon other considerations, as for instance their relative proximity to the factory, the relative facility of cutting and stripping, or the practice of previous years, so that in the first part of the crop, at least, some unripe cane is ground, instead of the riper cane which would give a higher factory yield. The cane growers who sell their cane to the mill are most prone to this mistaken practice.

(*To be continued.*)

AGRICULTURAL ABSTRACTS

Mechanization of Cane Planting Successfully Tested in Taiwan. J. C. CHOU. *Taiwan Sugar*, 1957, **4**, (12), 23–25.—A record is given of the work of a locally-designed planter.

* * *

Louisiana Variety Census for 1958. L. P. HEBERT. *Sugar Bull.*, 1958, **36**, 298–301.—Included in the account is a diagrammatic presentation of the annual varietal changes since 1941.

* * *

Losses on Transferring Anhydrous Ammonia. M. MAYEUX. *Louisiana Agric.*, 1958, **1**, (3); through *Sugar Bull.*, 1958, **36**, 231–232.—These losses are now estimated to be some 3·5%. Tests show that an ammonia powered pump can reduce these losses to under 1% and even 0·25%.

* * *

Outfield Sugar Cane Variety Trials, 1957. T. J. STAFFORD. *Sugar Bull.*, 1958, **36**, 313–330.—This is primarily a series of tabulated statements, for a large number of varieties, both established and unreleased, of the results obtained from trials under a wide range of conditions.

* * *

A Comparison of Yields of the Major Varieties in Babinda, 1957. A. G. BARRIE. *Cane Growers' Quarterly Bull.*, 1958, **22**, 6–8.—These varieties are : Badila, Pindar and Q 57. The last, first crushed in 1955, in 1957 provided 25·4% of the crop. Data are recorded indicating its superiority over the other two both in yield per acre and in c.c.s., particularly early in the season.

Release of CP 52–68. B. THIBAUT *et al. Sugar Bull.*, 1958, **36**, 258.—The main characteristics of this latest released variety are recorded.

* * *

Fresher Cane Increases Sugar Recoveries and Profits for both Growers and Processors. W. F. GUILBEAU *et al. Sugar Bull.*, 1938, **36**, 343–346.—Some startling figures are given to press home the importance of grinding only fresh and clean cane. In 1938 recovery was 80% but, by 1952, it had fallen to under 75% and present recoveries are between 75 and 76%.

* * *

Cane Cleaning at Hutchinson Plantation. ANON. *Sugar y Azúcar*, 1958, **53**, (8), 40.—Hawaii, having led in mechanizing the harvest, is leading also in solving the resultant problem of cleaning the cane before grinding. Such cleaning means the removal of extraneous objects ranging from 5 ton rocks and old motor cars to mud. In the cleanser briefly described, the cane descends a chute into a bath, in which water circulates, to be picked up by an elevator while the rocks and other heavier matter sink through the gap.

* * *

The New Varieties Q 63 and Q 65. C. G. STORY. *Cane Growers' Quarterly Bull.*, 1958, **22**, 9–11.—Q 63 (Trojan × CP 29/116) and Q 65 (POJ 2878 × Co 290) have been approved for the Mackay and Proserpine mill areas, and are described here. The former is generally resistant to disease, withstands flooding and forms a good substitute for Q 50 in early harvest ; the latter is less tolerant of wet soils, susceptible to chlorotic streak, but is a good substitute for Q 50 during the latter part of the harvest.

THE SUGAR CANE IN HAWAII

REPORT OF THE EXPERIMENT STATION, HAWAIIAN SUGAR PLANTERS' ASSOCIATION, 1956-57

THE Report, which runs to 75 pages, covers so wide a field that only a selection of the subjects is covered here.

Cultural Practices

The use of aqueous ammonia as a nitrogenous fertilizer is becoming widely adopted and now provides 57% of the total nitrogen purchased. Efficient methods for field distribution become of importance and, when this is made through the irrigation water, the problem becomes one of water distribution efficiency. Injection by equipment attached to planting machines and subsoilers raises questions of volatilization ; this was found to occur only in alkaline soils and at high N rates. In cold, wet soils nitrification is slow and ceases under extreme anaerobic conditions. Laboratory tests showed complete inhibition of nitrifying bacteria up to four weeks in the presence of a number of soil fumigants, 20 weeks being required for complete nitrification compared with eight weeks in their absence. Certain modifications have been made to the distributor used on aircraft in order to counteract irregularities in fertilizer distribution caused by the propellor slip stream. Lysimeter records are also given to indicate the relationship between losses of N and K through leaching and soil type.

Preliminary results of an (irrigated) experiment at Makiki, with N at 4 levels, 0, 100, 200 and 400 lb/acre (P and K being adequate) applied (1) all initially and (2) 25% initially and the remaining 75% after 13 months, show no differences at harvest (24 months) on fibre and stalk moisture but a higher % pol and lower non-sucrose juice solids from the higher dressings. On cane yield, delayed application held no advantage, as N at 200 lb was the limiting factor for the variety (37-1933) and border lines gave double the amount of sugar obtained from middle lines.

Interesting results are recorded on the effectiveness of raw rock phosphate on acid, phosphate-deficient soils, as demonstrated in pot experiments. The efficiency of raw rock phosphate is greatest when mixed with the soil and not banded ; at low pH (4·0), when mixed with the soil, it outyielded banded superphosphate. A summation of the experiments is that on soils such as these, large quantities of rock phosphate should be broadcast prior to deep ploughing.

Photosynthetic feeding of radio-active carbon (^{14}C) has disclosed certain interactions between P and K when the latter is deficient and has also been used in determining the first product of photosynthesis. Potash deficiency appears to lead to accumulation of inorganic phosphorus, particularly in the roots ; free malic acid alone was found to contain radio-active C and appears, therefore, to be the primary product. Experiments with radio-active sulphur indicate that almost all passes to the proteins.

Root studies are quoted as indication of the harmful effect of soil compaction through in-field road-ways. In soils in good physical condition, root penetration of the compacted horizon was reduced at 70 lb/cu. ft density, in low humic latosols it ceased at 87 lb/cu. ft and in a hydrol humic latosol it was reduced at 40 lb/cu. ft and ceased at 65 lb/cu. ft.

Irrigation

The irrigation studies are only broadly outlined. They include lysimeter experiments to determine moisture consumption by cane, particularly as a guide to efficiency in overhead irrigation. The measure is ET/EP where ET is the evapotranspiration of cane and EP the standard pan evaporation. A reference is given to field experiments into problems arising out of the decrease in the water supplied to the end of the furrow.

Mechanization

Mechanical appliances connected with the industry grow ever more complex and some of the latest machines are briefly described. The harvesting machines include a pickup transporter, weighing 22 tons, for V-cut cane which can load 30-74 tons per hr, according to length of haul, and a "liliko" pick-up machine[1]. The amount of cane left in the field after mechanized harvesting depends on the efficiency of the harvest method and, in the case of grab harvesting, much of the "liliko" is attached to the stool. Such complex machines are costly and the cost may well exceed their estimated worth. This problem is very briefly discussed in the case of a cutter-transport. A brief mention is also given (with illustration) of an experimental machine for injecting soil fumigants.

Weed Control

The number of chemicals available for weed control increases yearly and many of these have been subjected to trial, including a new "ARCADE" concentrate, an emulsion carrying the oil-soluble HSPA activator. In the case of gramineous weeds, there is always the possibility of damage to the cane. In this connexion, "Dalapon" is shown to be innocuous provided it does not come into contact with the above-ground cane. Several instances are noted of resistant strains in certain species of weed.

Varieties

No less than 4859 crosses were made during the 1956-57 season and, of these, only 689 were not of the several melting-pot series. The regional varietal distribution is given in some detail ; it shows the progressive varietal change typical of all territories. A brief reference is made to the joint 1957 New Guinea expedition to collect material from hitherto unexplored

[1] *I.S.J.*, 1958, **60**, 120.

regions in the hope of securing new germ plasm. The clonal material is planted in quarantine in Queensland and the seed, including that of *S. robustum* and *S. spontaneum*, at Beltsville and at the Molokai quarantine station.

Pests

An extension of the *Anomala* beetle (*A. orientalis*) from pineapple to cane fields in Waialua is noted. This extension involves a risk of invasion to other islands. The borer, *Rhabdoscelus obscurus*, is becoming more abundant on Kauai and Oahu, mainly following the spread of soft varieties ; it is kept under reasonable control by the tachinid *Microceromasia sphenophori*. No damage from army-worms is reported but the cut-worm, *Agrotis ypsilon*, continues its damage to young cane on Kauai. This changed status may be due to the different effects of weed control methods on it and its parasite, *Aplanetes marginiventris*, though the wasp remains still active. The discovery of a new immigrant, *Calendra cariosa*, a relative of the beetle borer, is recorded. In a pot experiment with mealy-bugs, control was exercised by spraying with a 0·25% emulsion of "Malathion", but without significant effect on yield. Can even a small infestation have a deleterious effect on cane ? This is a question having a bearing on the further question of varietal decline.

The rat problem, now transferred to the Department of Entomology, has as its primary objective the development of an aerial attack. The problem is complicated by the fact that four species are involved and these respond differently to baiting. The results so far are not easy to interpret, and somewhat disappointing. Meanwhile, trials with other poisons than the standard thallium sulphate continue. One promising bait is corn soaked or boiled in thallous sulphate and treated with 0·1% sodium benzoate ; this is as acceptable as rolled oats and, in addition, renders the bait completely resistant to moulds.

Nematodes, owing to their small size, are a pest which has largely been overlooked in the past. They are now being intensively studied as a potential participant in the yield decline. Several species, reported to be serious pests elsewhere, have been identified. Soil fumigation can be an effective control measure but the effectiveness depends on subtle adjustments to local conditions. In other crops, population patterns have been found to vary widely even within a small area and, presumably, the same is true of sugar cane.

Diseases

Varietal tests of the responses to Fiji disease, now being conducted in Fiji, have enabled an evaluation of the degree of resistance of most varieties to be determined. Less favourable results were obtained in the case of downy mildew through the uneven distribution on the carrier, Argus.

Red rot is spreading rapidly and its spread raises a serious problem in that 38-2915, occupying some 41,800 acres, is a highly susceptible variety. At present 39-3633 is the most resistant variety available. Meanwhile, as a temporary measure, control by fungicides sprayed or dusted by plane has been tried but without much success. Damage by chlorotic streak has been considerable in low-lying areas and transmission studies have been made. No transfer of the disease occurred when healthy and diseased cane were grown in the same drums, whether with or without nematodes. Root stunting, pineapple, mosaic and leaf scald diseases are noted as of minor importance and well under control.

Marked changes in the fungoid flora of the soil may take place after treatment with fumigants ; after treatment, *Trichoderma* spp. was found to be the dominant species. Species of this genus are known to be inhibitors of some plant pathogens, in particular *Pythium* and *Rhizoctonia*, but, in pot studies with several isolates of *Trichoderma*, no action, stimulating or inhibitory, was traced.

H.M.-L.

AGRICULTURAL ABSTRACTS

Sugar Beet May be Grown in Taiwan as a Commercial Crop Along with Sugar Cane. J. C. HUANG. *Taiwan Sugar*, 1957, **4,** (12), 13–21.—For three years field trials have been conducted with sugar beet and recorded here are the results of the trials for the 1955–56 and 1956–57 seasons. Yields ranging between 5,000 and 8,000 kg/ha have been recorded in the variety trials. Planting time trials indicate the optimum period to lie between Oct. 1 and Nov. 16. It is interesting to note that, among the proposals, is one for inter-cropping with sugar cane. Yields up to 30,000 kg/ha roots have been so obtained without affecting the yield of cane. It seems that Taiwan, like the Middle East, is an area in which a factory capable of handling both beet and cane will be a promising venture.

* * *

Some Soil Management Practices in the Mackay District. C. G. STORY. *Cane Growers' Quarterly Bull.*, 1958, **22,** 27–30.—The soils referred to are heavy, black clay loams, generally with poor drainage, which occupy a considerable area in the District. Systems of ploughing and of fertilization are described, but the main interest lies in the use of bagasse, of which there is an excess of some 30%, as a blanket even up to 1 ft deep and subsequently worked in. Present limited experience suggests that, on these soils, bagasse would prove superior to green manure every third year.

IN PURSUIT OF QUALITY

IN the attempt to secure maximum yield of sugar per acre, the crop-logging system evolved by H. F. CLEMENTS has become widely adopted in Hawaii on a field scale. Under it, the nutrient status of certain selected tissues are determined at intervals throughout the growth of a crop and the status of each element, whether too high, normal or too low, indicated. Thereby the fertilizer programme can be adjusted. In the case of cation nutrients the demand is constant throughout growth and, in the chart, the appropriate level is indicated by a straight line. In the case of nitrogen, the position is different ; not only does the demand for N differ seasonally and with the age of the crop, but the available N in the soil can vary widely as a season progresses. Within the range of normal agricultural practice N is the dominant nutritional determinant of both yield and quality in sugar cane. Thus, the question arises : on what factors does the N level, as commonly determined from the chlorenchyma of leaves 3-6, depend. A detailed study of this aspect is given by H. F. CLEMENTS in *Crop-logging of Sugar Cane : The Standard Nitrogen Index and the Normal Nitrogen Index*[1].

If the *N* status is to form the basis of a fertilizer programme, it is first necessary to be sure that there are no other factors influencing it to a dominating degree. Among the possible factors are : sunlight, maximum and minimum temperatures, total sugars, sheath moisture and age. For the purpose of determining the influence of these, some of which are interdependent, the method of partial regression is adopted for which ample data are available from the wide use of crop-logging under a range of ecological conditions. The results indicate that, with the multiple correlation *R* as the measure, sheath moisture and age with, in certain cases, maximum temperature, give an adequate measure of the combined influence of the external factors. This holds for all varieties. For practical purposes it is sufficient to consider only sheath moisture (moisture content of sheaths 3-6 expressed as % green weight) and age.

Two new concepts now come in ; the first is that of a Normal Nitrogen Index (NN) representing the average index for a given sheath moisture and age for crops which have given outstanding yields, the second is that of a Standard Nitrogen Index (SNI) indicating what the actual Leaf Nitrogen Index would be were the sheath moisture and age other than they actually were. As examples :—

$$NN = 0{\cdot}04122 X_1 - 0{\cdot}02212 X_2 - 1{\cdot}42077$$

where X_1 is actual sheath moisture at sampling and X_2 age at sampling and

$$SNI = N_1 + 0{\cdot}04122 (M_2 - M_1) - 0{\cdot}02212 (A_2 - A_1)$$

where N_1 is the observed leaf nitrogen and M_2 and M_1 with A_2 and A_1 respectively the desired and actual sheath moistures and ages. The NN index can now be plotted ahead and fertilizer requirement will be indicated by the position of the actual leaf nitrogen figure relative to the calculated, a finer adjustment being made through the SNI. It is not possible here to follow up the discussion of the numerous applications to which these two indices can be put.

In a further paper, *Quality in Hawaiian Sugar Cane*,[2] H. F. CLEMENTS adopts the same system of analysis by partial regression to ascertain what factors are of major influence in determining the sucrose present at harvest, and again data are drawn from crop-logs covering a wide range of conditions. Preliminary tables give, for each internode and at 35-day intervals throughout the crop, reducing sugars and sucrose as % dry matter, and sucrose and moisture as % green weight. The striking point in these tables is that the sucrose % dry matter varies only slightly, and that irregularly, for all internodes and at all ages ; it is the reduced moisture % as the stalk ages which accounts for the improved quality of cane as it matures. Furthermore, evidence is given indicating that sugar continues to be deposited in the internodes long after the respective leaves have fallen.

It is not possible here to follow in any detail the discussion in the second part of the paper in which the measures of quality taken are Brix, purity, pol in juice and tons cane/tons sugar and the influencing factors, trash at harvest, average light, wind, maximum and minimum temperatures for the 90-day period prior to harvest, sheath, moisutre levels at 12-18 months, the last 6 months and final, leaf N level at 12-18 months and final, and lastly age at harvest. The multiple correlation, *R*, is of the order of over 0·7 (in the examples given between 0·689 and 0·752). As in the case of NN and SNI, equations have been worked out for all four measures of quality of which may be given as an example that for tons cane per ton sugar (TC/TS) :—

$$TC/TS = 0{\cdot}04712 X_1 + 1{\cdot}9043 X_2 + 0{\cdot}13437 X_3 + 0{\cdot}12891 X_4 - 17{\cdot}1132$$

where X_1 is maximum temperature, X_2 final leaf N, X_3 final sheath moisture and X_4 minimum temperature.

H. M.-L.

Abnormalities in Sugar Beet caused by Herbicides. L. COSTA and D. RUI. *Ital. agric.*, 1958, **95**, 75–8; through *Field Crop Abstracts*, 1958, **11**, (3), 193.— Abnormalities in sugar beet induced by 2,4-D treatment of nearby weeds during a slight breeze are described. The young sugar beet plants had their first few leaves. Although 50–60% of them were affected they appeared normal two months later.

[1] *Hawaii Agric. Exp. Sta. Tech. Bull.* (Univ. Hawaii), 1957, (35), 56 pp.

[2] *Hawaii Agric. Exp. Sta. Progress Notes* (Univ. Hawaii), 1958, (115), 25 pp.

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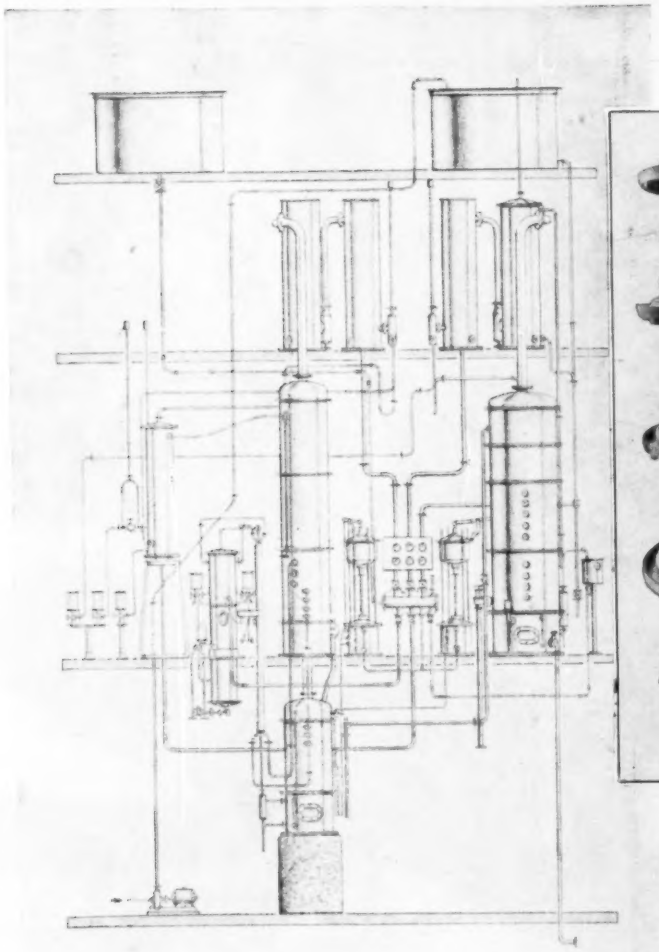

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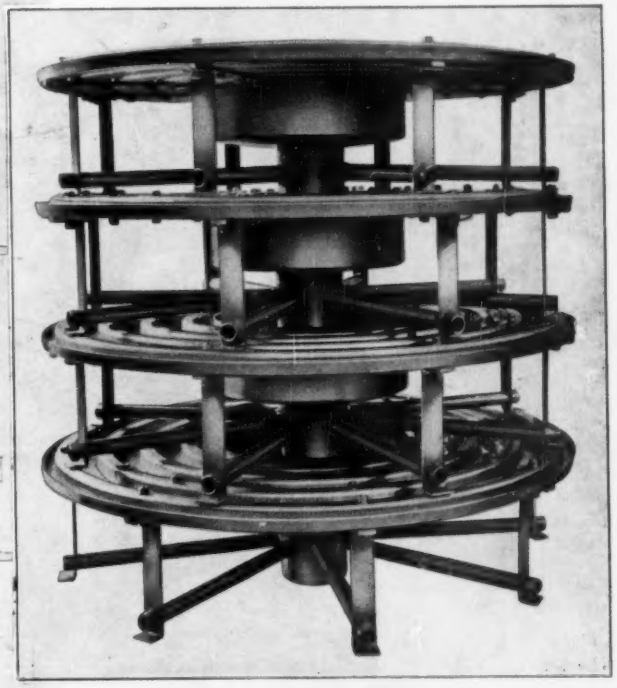

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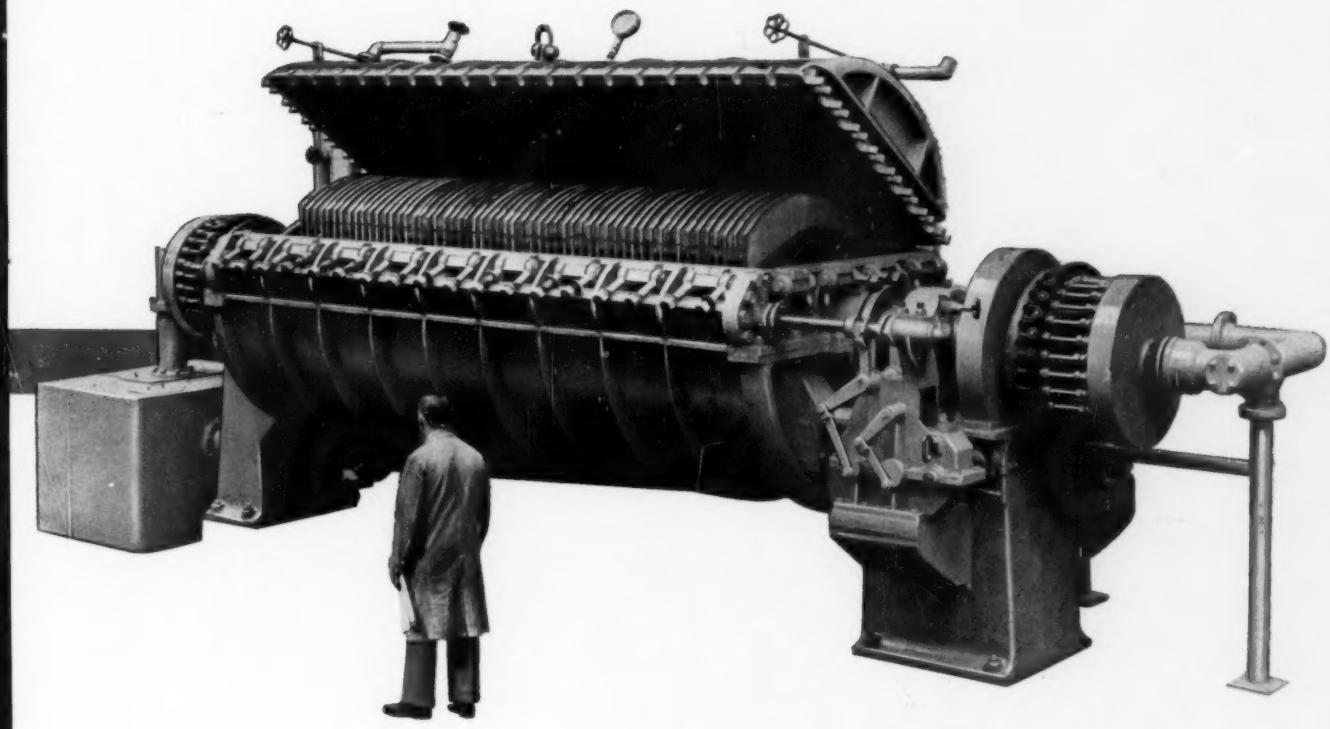

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THE DETERMINATION OF THE APPARENT PURITY OF BEET SUGAR FACTORY JUICES AND SYRUPS

By WM. H. PARKER, M.Sc., Chief Chemist, British Sugar Corporation Ltd.

PART II.

(*B*) Purity by Conductivity.

The purity of a normal beet sugar factory process liquor can be determined by measuring its conductance, because for any given type of juice or syrup there is a fairly constant proportionality between the organic and inorganic impurities and also between the electric conductance and the inorganic impurities present or, conversely, the purity. The successful application of this method depends upon two features :—

(*a*) Samples of process thick juices or syrups (greens, etc.) are tested each day by the normal method to determine the purity and these are used for "standardising" the conductivity meters used.

Note.—If changes are made during the 24 hours in the quantity of soda ash, etc. used in the process, this will affect the conductivity/purity relationship and in such cases new standards have to be prepared for each change.

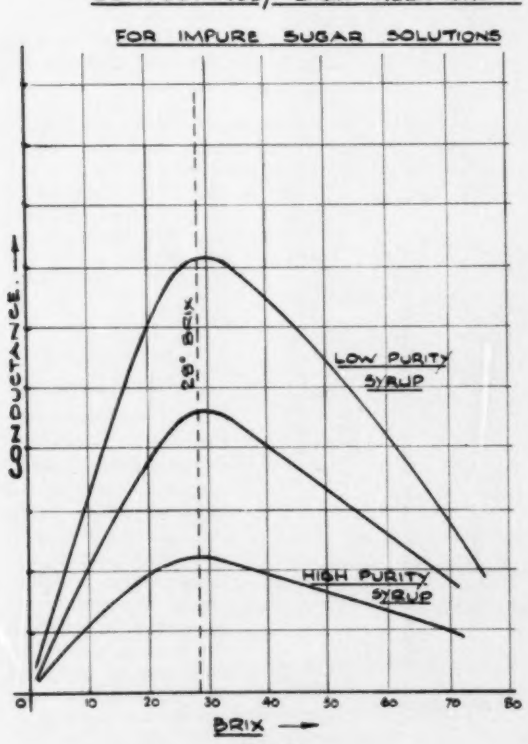

Fig. 3

(*b*) The conductance of an impure sugar solution is practically constant at a density corresponding to approximately 28° Brix (±2° Brix). This makes the method all the more convenient because solutions do not have to be diluted to *exactly* 28° Brix for making conductivity measurements.

This principle is illustrated in Fig. 3 which depicts typical graphs showing the relationship between ° Brix and conductances of three types of syrups.

In making a purity determination by this method the heavy liquor under test is diluted to approximately 28°Brix using ordinary distilled water which, although not entirely necessary, for low purity products, is safe. The conductance of the standard corresponding to the sample under test is first measured and the result, corrected to 20°C, is noted. There is no need to calculate the specific conductance (or specific resistance) since variations in the cell constant will cancel out by this method. The electrodes are then placed in the test solution and the conductance measured. The result is corrected to 20°C and noted. The purity is then calculated thus:

Let X = Purity of the solution under test,

P_s = Purity of the corresponding standard soln.,

C_s = Conductance of corresponding standard sln. at 20°C.

C_x = Conductance of the test solution at 20°C.

Then the purity of the test solution $X = 100 - (100 - P_s)\frac{C_x}{C_s}$. If the measurements are made in ohms and R_x = resistance of the test solution at 20°C,

R_s = resistance of the corresponding standard at 20°C,

then the purity of the test solution $X = 100 - (100 - P_s)\frac{R_s}{R_x}$.

Conductometers can quite easily be fitted with home-made scales to give direct readings of purity and instruments were originally used in this way by the Corporation. However, a completely automatic apparatus for purity determinations has now been developed and is known as the "Bondanco" purity meter. This incorporates

(*a*) An automatic diluter designed by A. E. Cragg and J. Pratt (*D*, Fig. 5) described in detail below.

(*b*) An automatic mixer and heater/cooler designed by G. M. BOND (*C*, Fig. 5). This automatically stirs and adjusts the test solution to 20°C before discharging it automatically into the test cell. Details are given in Fig. 6.

(*c*) An unbalanced bridge designed by D. F. A. HORSLEY (*H*, Fig. 7).

(*a*) *The "Cragg-Pratt" Automatic Diluter*

As already mentioned the general arrangement of this piece of apparatus is shown in Fig. 4 and the following are the details of the various parts.

A is a brass container, shaped as shown, about 3¾ inches in diameter and 4 inches deep with a copper draw-off tube soldered into the dished bottom. The over-flow is a ⅝-inch i.d. copper pipe 7–8 inches long and fixed ¼ inch below the rim of the vessel, giving a working capacity of about 600 ml. The legs are constructed of flat bar and arranged to fit tightly into the corners of the square balance pan on which the whole rests. They are long enough to give sufficient height for the draw-off pipe to clear at an easy angle.

B is a glass oil-cup—3 inches in diameter by 3 inches deep—in the bottom of which is a layer of mercury about ¾-inch deep. It is fitted with a wide overflow central pipe, a syphon tube *D*, and into it the diluting water is fed. The height of *B* above *A* is such that the dilution water passes steadily through the syphon tube to give a sharp cut-off at 28°Brix.

C is a $\frac{3}{16}$ inch diameter steel rod fixed to the scale pan which carries the weights *F* and *E* and is so shaped that it carries the syphon tube *D* which is attached firmly to it. The height of *C* must be sufficient to clear the vessel *B*.

D, the syphon tube, is of copper or brass of ¼ inch o.d. with a short length of glass tubing fitted to each end. The level of *B* is so adjusted that when the scale pans are nearly in balance the water syphoning over is not forceful enough to carry mercury over from *B*. The one end of *D* just touches the mercury surface when the scale pans are exactly balanced thus forming a seal, and the other end dips into *A* to within about 1 inch from the bottom which it must not touch at any time.

E and *F* are weights, *E* to balance *A* when empty and *F* to bring the contents of *A* to 28°Brix.

The procedure is as follows :—

Turn on the water supply with the syphon tube *D* full of water. Water will run into *B* and overflow down the centre tube with the scale pans just balanced. None will pass into *A* because of the mercury seal in *B*.

With *A* completely empty the weight *E* balances *A*. The weight *F* is now added to the scale pan alongside *E*. The heavy syrup under test is poured into *A* until the scale pan on that side goes down and the other scale pan rises. This causes *C*, and consequently *D*, to rise, the mercury seal is broken, and water syphons from *B* into *A* and mixes with the syrup which is gradually diluted. Surplus liquid escapes to waste through the overflow pipe until the mixture in *A* approaches 28°Brix. The amount overflowing gradually decreases as the scale pan slowly rises and stops at balancing point when the desired point of 28°Brix is reached.

The contents of *A* are then discharged by opening the pinchcock attached to the draw-off tube and will be found to be very close to 28° Brix.

The balance used is a Berenger massecuite balance of 3 kg capacity sensitive to ± 1 gram. In the "Bondanco" automatic purity apparatus, described below, a 1 kg laboratory scale, model L.33[1], turning to ± ½ gram is used with the tare bar removed and having a rise and fall of 1½ inch. This is important.

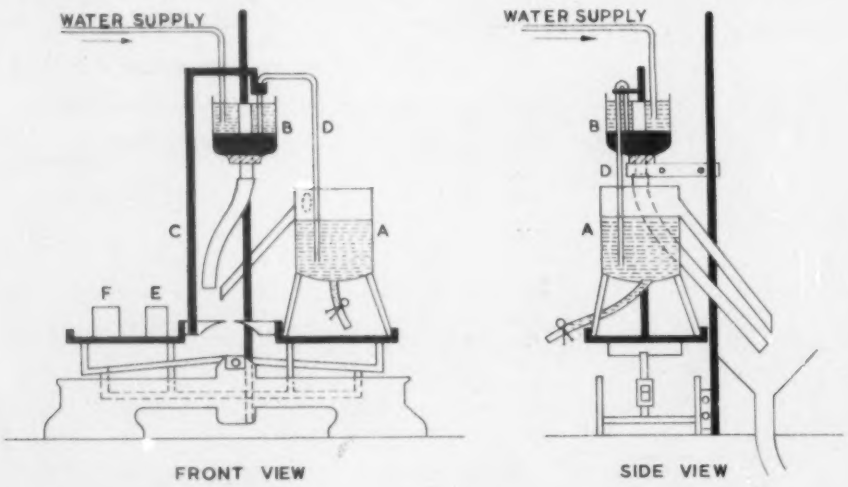

Fig. 4.

The "Bondanco" Purity Meter

In the original conductivity measurements made using mains-operated bridges fitted with oscillators working at 1000–3000 cycles/sec, temperature compensation was too prone to errors at purities lower than about 80. One way of avoiding this is to ensure that

[1] Suppliers: Wm. Webb Ltd., Ilford, Essex.

all the standards and the test sample are kept at the same temperature — preferably that of the laboratory.

The present apparatus is fully automatic inasmuch as it dilutes to 28° Brix, mixes, cools to 20°C (or any predetermined temperature) and the purity is indicated on a milliammeter calibrated directly in Purity (*A*, Fig. 5). The whole is mounted on a single panel of suitable dimensions.

The delivery of the 28° Brix solution from the diluter is effected by a mercury seal in which the discharge pipe is immersed to a depth of $\frac{3}{4}$ in to 1 in. As the scale nears equilibrium, this take-off emerges from its seal, and the 28° Brix solution is discharged via the funnel surrounding the seal, and piped down to the cooler.

While the solution is rising on the inner compartment, a float is being raised. To this are attached two miniature mercury switches, MS1, which switches on a motor to drive the stirrer, and MS2 which switches off the heater and is referred to later on.

Fig. 5.

Two "Meccano" 1-in pulleys, bored out to $\frac{3}{16}$ in, and a small rubber band are used to rotate the $\frac{3}{16}$ in steel shaft which is immersed to the bottom of the inner tank of the cooler. Fitted to the bottom of this shaft is a small impeller—in actual fact this is the cooling fan supplied with the motor.

When the juice has cooled to the working temperature required—20°C or the ambient of the laboratory, whichever it is decided to use—the thermostat makes contact and energises an electromagnet[2] (EM, Fig. 6), which opens the drain valve at the bottom of the cooler and the juice, now at 28° Brix and 20°C, is discharged into the bottom compartment. Quick discharge is achieved by keeping the magnet gap small and by gearing up the movement by means of levers.

As the juice leaves the cooler, the aforementioned float sinks, contact at MS1 is broken and the motor stops. At the same time MS2 switches in a small heating coil, of about 12 watts, which is fitted alongside the active spiral of the thermostat.

[2] Londex Ltd., Anerley Road, Sydenham, London, S.E.20.

The ensuing rise in temperature causes the thermostat to break contact after about 20 seconds, and this in turn de-energises the electromagnet and closes the valve at the bottom of the cooler (see Fig. 6).

The time taken in resetting the valve to its normal closed position can be varied by use of the "Accelerate Extinction" switch which brings in a set of resistors in series with the heater (AE, Fig. 5).

A pilot light is also fitted which glows red while the valve is open, and constitutes a warning not to use the diluter for the next test until extinguished (R, Fig. 5).

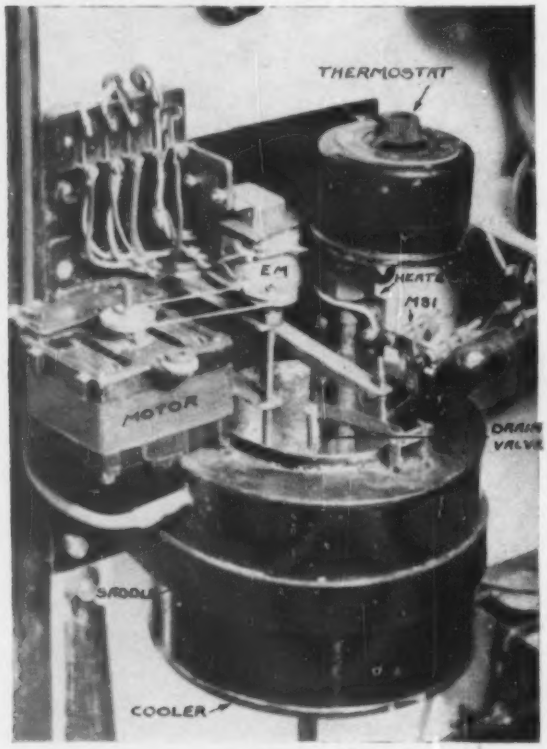

Fig. 6.

The bottom compartment referred to above is a copper bath, into which the liquor under test runs after it has reached the desired Brix and temperature and in which are suspended four brass tubes closed at the bottom. A fifth has an open end (T, Fig. 5). The three nearest the panel on which the apparatus is mounted contain standard juices of 90, 80 and 70 purity approximately, and the fourth contains water for washing the electrodes (E, Fig. 5). With this arrangement the standards and washing water are maintained at the same temperature as the solution under test.

The procedure is as follows: place the cell in the appropriate standard and adjust the calibrated meter to read the known purity of the standard by use of the knobs marked "Coarse" and "Fine" (R3 and R4 respectively, Fig. 5). Transfer the cell to the open-ended brass tube referred to above, now filled with the test liquor, the purity of which will then be indicated on the meter.

It should be noted that the standards are surrounded by the liquor under test, so that any small differences in temperature will disappear in a very short time. It is thus seen that the use of the open-ended container is to provide the cell with a support and to simulate the conditions of the standards. The juice should be retained in the cell bath until the apparatus is required to make the next determination.

The motor used is a tape-recorder motor[3] wound for 230 volts A.C. The coils were unwound and rewound with 24 s.w.g. enamelled wire for use at 12 volts A.C. as a safety measure. The Londex electromagnet is fitted with a No. 39 coil for operation on 250 volts A.C. A "Memlo" transformer is fitted at the back of the panel, and as this is centre-tapped, will supply both 12 and 25 volt circuits. A wiring diagram is given in Fig. 7.

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WIRING DIAGRAM

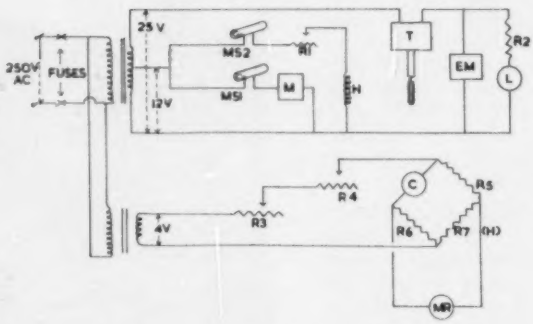

Fig. 7.

KEY TO DIAGRAM.

MS1, MS2 = Float-actuated miniature mercury switches.
M = Motor rewound for 12 volts (Collaro type A.C.49).
T = Thermostat type T.S.3 (Sunvic Controls Ltd.) .
H = Heating coils.
L = Lamp 6·3 volts, 0·3 amps. (Lamp holder from Bulgin type D.681).
MR = Milliammeter 0–1 with rectifier (Electrical Instrument Co., Glasgow).
EM = Electromagnet. 39 coil. (Londex Ltd.).
C = Cell. Small electrode type. (Mullard Ltd.).
R1 = Hand-made tapped resistance coil.
R2 = 75 ohm fixed 3-watt wire wound resistance. (Radiospares Ltd.).
R3 = 200 ohm variable W.W. resistance. (Radiospares Ltd.).
R4 = 10 ohm variable W.W. resistance. (Radiospares Ltd.).
R5 = 1000 ohm variable W.W. resistance. (Radiospares Ltd.).
R6 = 47 ohm variable W.W. resistance. (Radiospares Ltd.).
R7 = 57 ohm variable W.W. resistance. (Radiospares Ltd.).

[3] Supplied by Collaro Limited, Barking, Essex.

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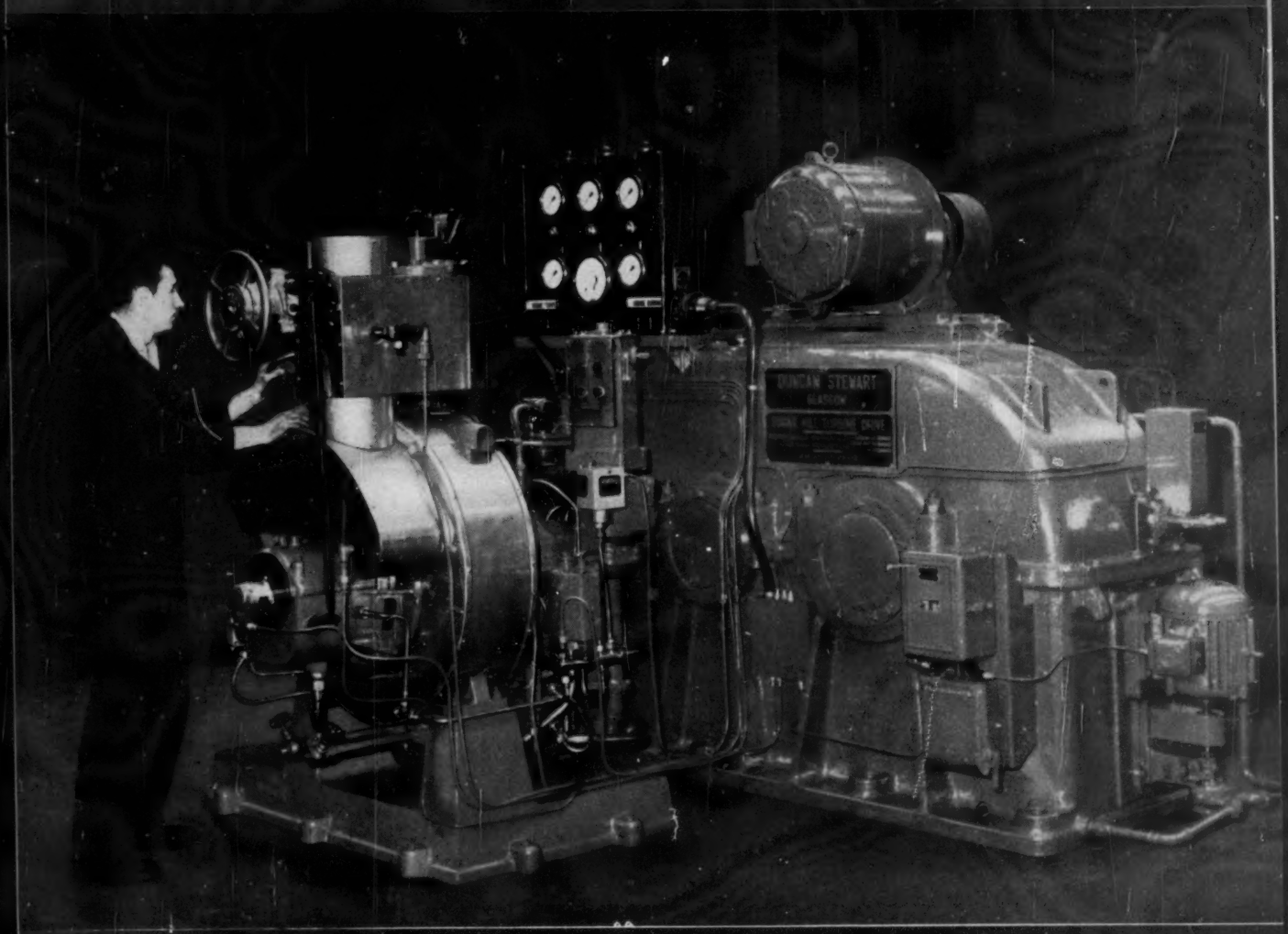

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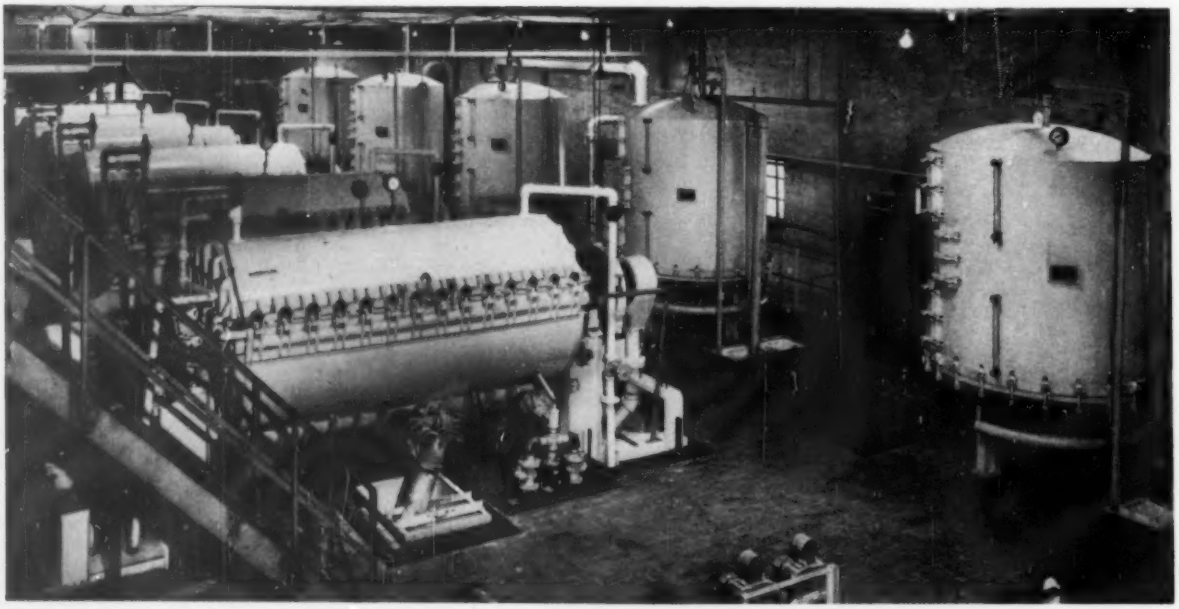
Filtration Station at Sezela Refinery in Natal, South Africa, showing the Auto Filters on the left and Fas-Flo Filters on the right.



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The calibration required care and for this purpose various mixtures of white sugar and molasses to cover the whole working range of purities were used. The purity of these must be determined accurately. The cell is immersed in each calibrating mixture in turn and the readings in milliamps noted. A graph is plotted of the milliamp readings against the purities and this is used to replace the existing milliameter scale by a new scale graduated to give direct readings of purity between 57 and 95.

One or two items need pointing out to those intending to make this apparatus.

First, the scale pan of the diluter needs to have a stroke of not less than 1 in—or in other words full immersion of the take-off pipe in the mercury must be enough to oppose the head of juice in the scale pan.

Second, the capacity of the diluter must be sufficient to almost fill the cooler.

Third, the size of the cell compartments must be similar.

The ideal is to obtain or make four electrodes which are identical physically and electrically, three to be immersed in the standards and one in the test liquor. A rotary switch would then select the required cell and obviate any pollution of standards by repeated transference of the electrodes.

With this apparatus purity determinations on syrups, etc., can normally be made as fast as they can be prepared for feeding into the diluter.

The author wishes to express his thanks to the Directors of British Sugar Corporation Ltd. for permission to publish this work.

LABORATORY VACUUM PAN AND GRANULATOR FOR SUGAR PRODUCTION

By F. G. EIS and W. A. SACKETT

(Research Dept., Spreckels Sugar Company, Woodland, California)

PURE granulated sugar is obtained by crystallization in vacuum pans, followed by separation of the syrup phase in centrifugals, and drying in rotary granulators.

For many research and development purposes it is advisable to simulate factory-scale processing on the bench, and for such purposes it is essential that the small units yield products comparable to the simulated apparatus. The bench-scale equipment described here for the crystallization and drying of sugar, was designed to duplicate the results of practice, rather than to be used in fundamental studies of crystallization.

While laboratory apparatus purportedly suitable for the crystallization of sugar from syrups, and for the separation and drying of the crystals, has been found, in general, to produce sugar not equivalent to that obtained in full-scale operation, the differences appear to be associated with variations in sugar quality due to difficulties in vacuum pan

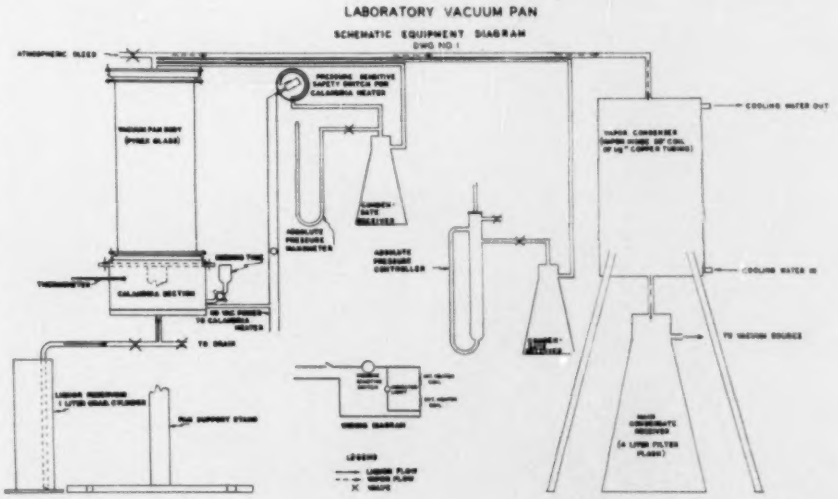
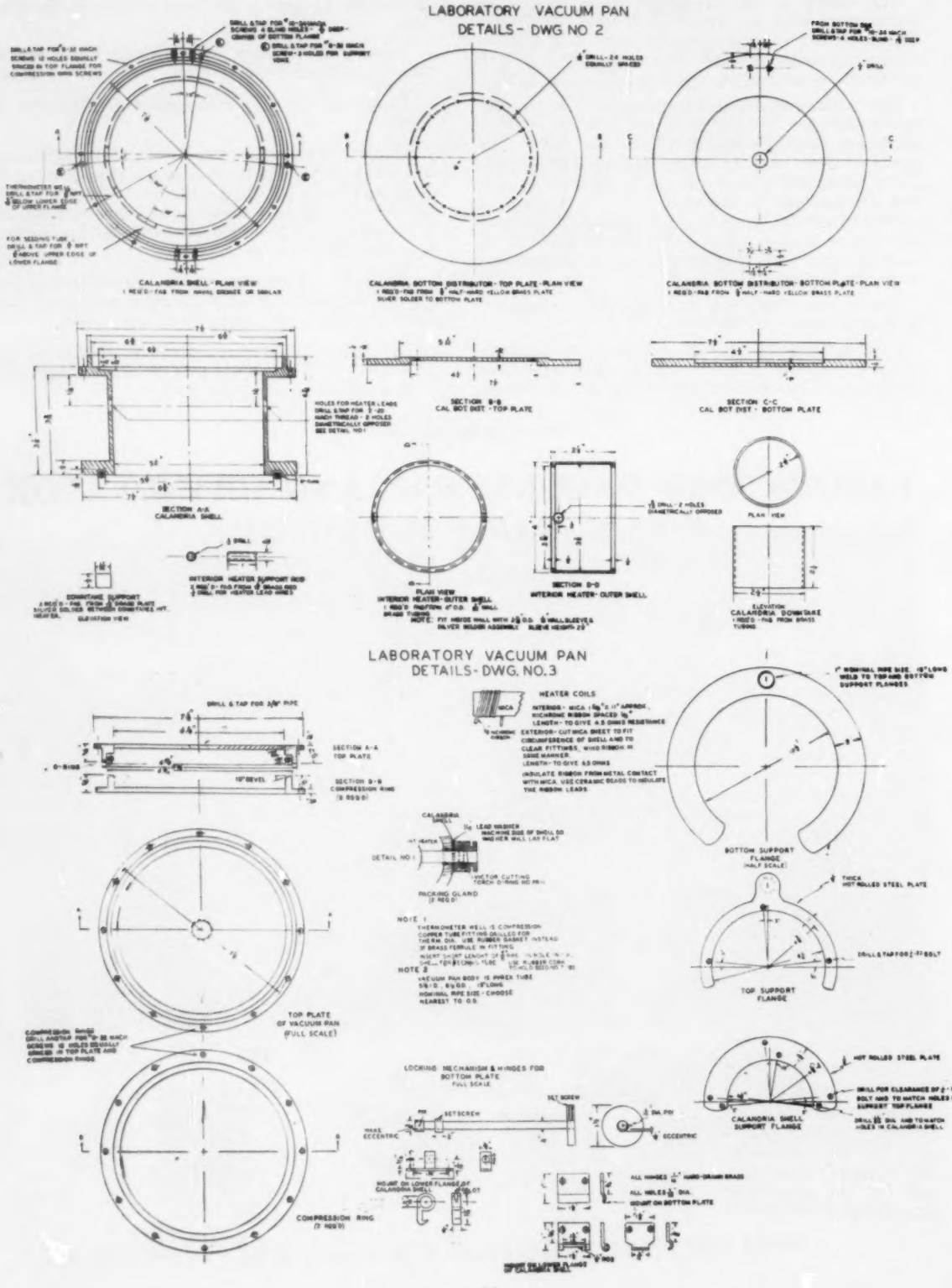


Fig. 1


LABORATORY VACUUM PAN
DETAILS - DWG NO 2
CALANDRIA SHELL - PLAN VIEW
CALANDRIA BOTTOM DISTRIBUTOR - TOP PLATE - PLAN VIEW
CALANDRIA BOTTOM DISTRIBUTOR - BOTTOM PLATE - PLAN VIEW
SECTION A-A
CALANDRIA SHELL
SECTION B-B
CAL BOT DIST - TOP PLATE
SECTION C-C
CAL BOT DIST - BOTTOM PLATE
DOWNTAKE SUPPORT
INTERIOR HEATER SUPPORT ROD
PLAN VIEW
INTERIOR HEATER - OUTER SHELL
SECTION D-D
INTERIOR HEATER - OUTER SHELL
ELEVATION
CALANDRIA DOWNTAKE
LABORATORY VACUUM PAN
DETAILS - DWG. NO. 3
SECTION A-A
TOP PLATE
SECTION B-B
COMPRESSION RING
HEATER COILS
BOTTOM SUPPORT
FLANGE
HALF SCALE
TOP PLATE
OF VACUUM PAN
(FULL SCALE)
DETAIL NO 1
PACKING GLAND
TOP SUPPORT
FLANGE
LOCKING MECHANISM & HINGES FOR
BOTTOM PLATE
FULL SCALE
CALANDRIA SHELL
SUPPORT FLANGE
COMPRESSION RING

operation and control, to minute contaminations causing excessive sugar solution turbidity, and to formation of crystal conglomerates during drying.

Laboratory Vacuum Pan

The design adopted is an electrically-heated, calandria-type unit with glass-cylinder body and a crystal-syrup mass (fillmass) capacity of about six litres. A schematic equipment diagram is shown in drawing number 1 and vacuum pan details in drawings 2 and 3. Fig. 4 shows the complete laboratory pan with associated equipment.

Boiling control is based on maintaining a predetermined supersaturation-time curve. Published supersaturation curves are used[1]. Temperature adjustments of a few degrees from these curves are sometimes necessary for satisfactory results with different juices. A boiling temperature of about 60°C has been found to maintain adequate circulation and to allow a reasonable sugar yield. Before emptying the crystallized mass from the pan, it is heated to about 75°C to reduce the fillmass viscosity for satisfactory separation in the laboratory centrifuge.

A detailed outline of boiling procedure follows :

1. Sufficient syrup is drawn into the clean pan to cover the heating element when concentrated to the seeding density. This is normally 1200 ml of juice of 65% solids contents.

2. The heater is turned on and the absolute pressure adjusted to the value desired, normally 10 cm Hg.

3. When the proper supersaturation is reached, which is usually at a 61°C fillmass temperature with 10 cm Hg absolute pressure, the pan is seeded with a suitable quantity (0·5 ml) of a slurry of powdered sugar in isopropyl alcohol (25 g of 325—mesh powdered sugar per 200 ml.)

4. After seeding, the temperature is allowed to rise one degree ; then the syrup feed is started and the temperature is held constant by adjusting the syrup feed.

5. Boiling is continued until the desired size of crystals is obtained. Slight variations in temperature are used to control the viscosity of the fillmass. A temperature increase of about 2°C from the start to the end of the boiling maintains proper supersaturation without entering the spontaneous graining range.

6. When the desired grain size and yield is obtained the feed is shut off and the absolute pressure is slowly increased to heat the fillmass to 75°C.

7. Upon reaching the desired temperature and consistency of fillmass for centrifuging, the heater is turned off, the vacuum released, the bottom door removed and the fillmass dropped into a suitable container.

8. The fillmass is immediately centrifuged. Boiling distilled water is used for a wash. The wash water is applied through a Monarch Fig 631 3/32 nozzle with pressure developed by a model E. Eastern centrifugal pump.

9. Quality analyses are made on the dry sugar from the laboratory granulator described below.

A typical series of comparisons of the solution colours and turbidities of granulated products boiled in the laboratory vacuum pan is given in Table 1. Values of colour and turbidity are expressed in indices determined by the Morse and McGinnis method[2].

In general the laboratory pan has been found to yield a product slightly lower in solution colour and turbidity than that obtained in factory operation. The sugar from the laboratory pan compares favorably with that from the factory pan in all quality factors. Colour and turbidity comparisons have been tabulated here, as experience with former equipment has shown

[1] Gillett : Low Grade Sugar Crystallization. (California & Hawaiian Sugar Refining Corp. Ltd., Crockett, Calif.) 1948.
[2] *Anal. Chem.*, 1942, **14**, 212–214.

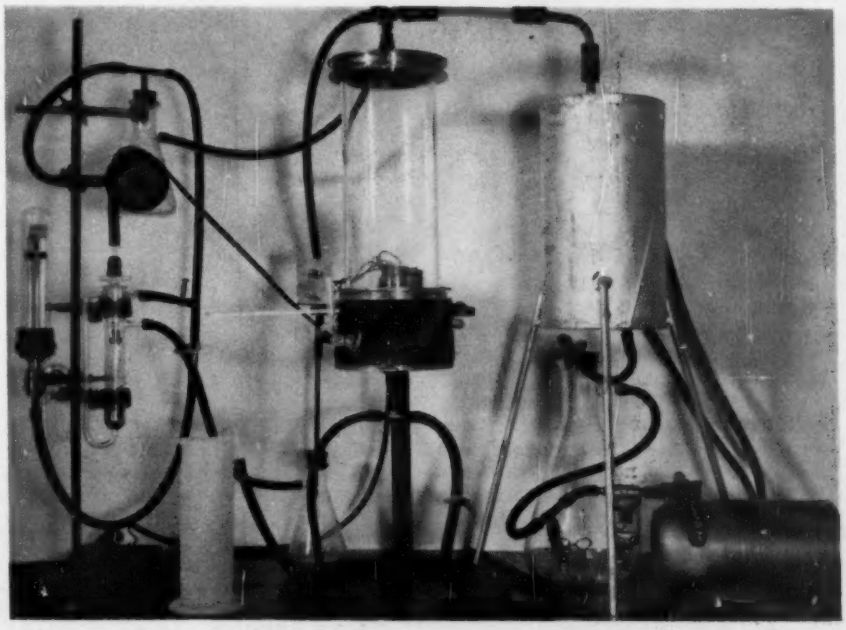


Fig. 4

Fig. 5

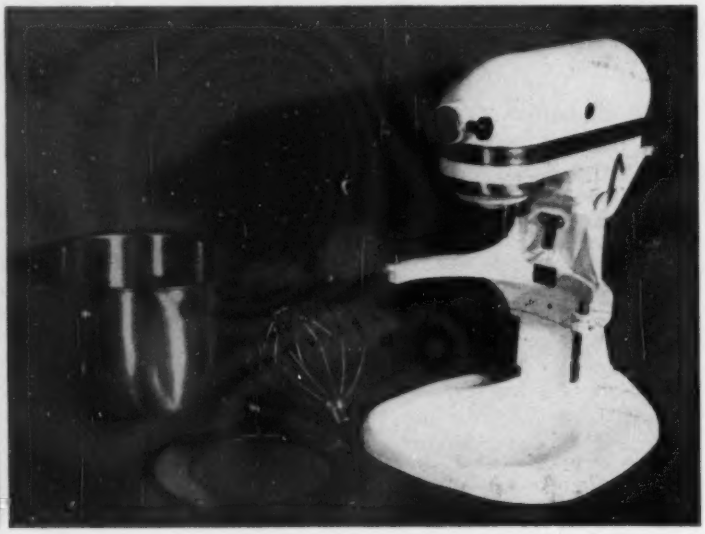


Fig. 6

that these quality factors are the most difficult to duplicate on the laboratory scale.

TABLE 1.

Sugar Quality.

	Laboratory Product Solution		Factory Product Solution	
	Colour	Turbidity	Colour	Turbidity
1	17	4	21	11
2	20	4	23	8
3	20	5	23	8
4	22	5	25	8
5	25	11	23	12
6	19	11	19	14
7	19	11	21	14
8	23	11	23	12
9	22	10	23	13
10	16	7	17	10
Average	20	8	22	11

LABORATORY GRANULATOR

Previous laboratory-scale methods available for drying the sugar after separation from the mother liquor and washing in the centrifuge were not satisfactory with respect to a number of quality factors. Drying without constant agitation of individual crystals leads to formation of conglomerates and invalidates crystal size determinations on the finished products. When drying with agitation, difficulties associated with the need for gentle action to avoid fracture of crystals, and need for avoiding the pick up of foreign materials impose severe difficulties on the small scale, where the ratio of equipment surface to material amount is so much greater.

A method of drying sugar in the laboratory, without increase in solution colour or turbidity, and yielding a product with granulation satisfactory for sieve testing, was developed. The apparatus shown in Figs 5 and 6, consists of a " Kitchen-Aid " mixer, model K 5-A, with a stainless steel bowl and wire whip. The outer top of the bowl is covered with a stainless curbing to reduce the incidence of crystals leaving the bowl during agitation. About a pound of sugar can be dried under usual ambient air conditions in about five minutes.

A comparison of the quality of sugar dried in the laboratory apparatus with that produced in the factory is given in table 2. Moisture content equal to that obtained in the factory is readily obtainable.

TABLE 2.

	Solution Colour-Turbidity			Sieve Test MA-CV*	
	Wet	Laboratory Dried	Factory Dried	Laboratory Dried	Factory Dried
1	23– 8	21– 9		331–21	355–26
2	19–11	21–11	21– 7	355–27	352–28
3	19– 7	21– 5	21–16	360–27	370–23
4	21– 7	21– 7	29– 8**	347–24	350–25
5	21– 7	23–10	23–10	367–27	331–30
Average	21– 8	21– 8	24–10	352–25	352–26

* MA-CV Mean aperture in microns and coefficient of variation.

** Colour increase in factory operation due to excessive heat.

The values of solution colour and turbidity of wet and laboratory-dried sugar are of sugars originating from the same sample of sugar taken from the factory centrifugals. The sieve test values were obtained by analysis of this wet sugar after drying in the laboratory apparatus and in the factory granulators.

The data show that there is little difference in the colour and turbidity of the wet sugar and the sugar

(*Continued on page* 18).

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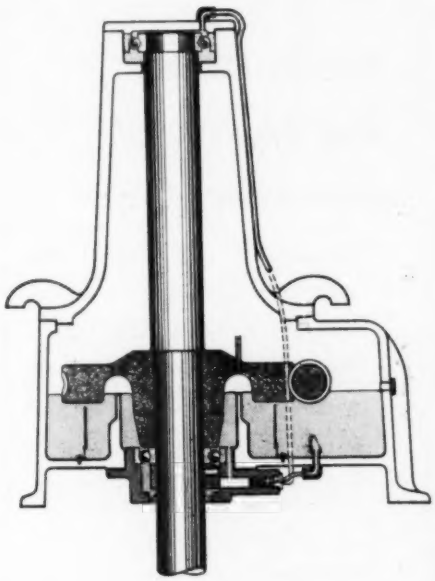

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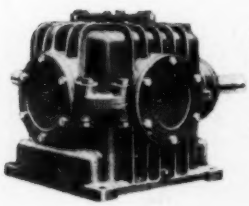

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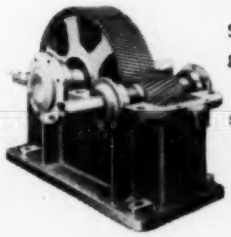

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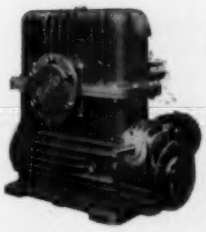

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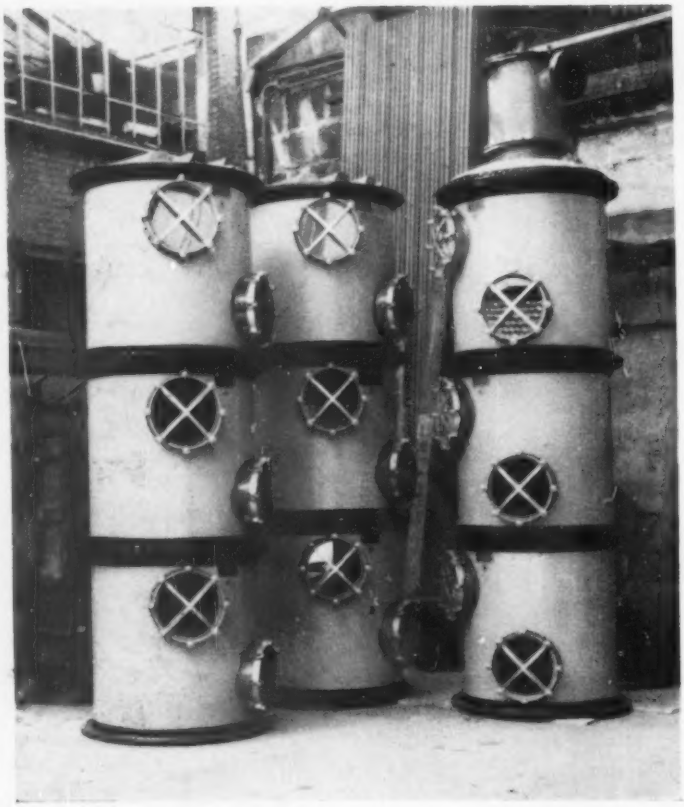

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KEEPING THE LEAD SINCE 1840

INCLUSIONS

By H. E. C. POWERS, (Tate & Lyle Ltd., Thames Refinery, London, E.16.)

Paper presented to the 11th Tech. Conference, British Sugar Corp., 1958

PART I.

ONE of the primary efforts of the sugar producer is to separate the sucrose from the unwanted foreign matter. Crystallization is a remarkably successful way of doing this, but its effectiveness is undermined when foreign matter is embedded in the crystal structure, and hence cannot be washed off. Such intrusion is herein termed inclusion.

The Oxford Dictionary gives a very good definition of inclusions—"That which is included". The sucrose crystal appears to accept this as a challenge. Once a crystal is growing vigorously it seems to be able to "include" almost anything in its interior with the aid of the ever-active layer growths.

Isolated pools of mother liquor which have been left in a "backwater" and can no longer maintain the pace ; air bubbles which have been liberated from solution upon the growing face, solid foreign matter, whether it be completely foreign, like sand or rust, or whether it has also been crystallized from the mother liquor—all are grown-in without appearing to inconvenience the crystal in the slightest degree. One of the most remarkable examples I have seen was that of a crystal which commenced as a nucleus on the side of a sheet of metal suspended in liquor. It grew until it included part of the metal sheet, then, ever ambitious, grew mainly in one direction towards another suspended sheet. This also it enveloped in its stride, and I hope you will, as I do, pay homage to the crystal which refused to let two indigestible sheets of metal disturb its natural development.

Lest any should feel it improbable that syrup in what I have termed a "backwater" can be grown-in, we have done this artificially. A tunnel was bored right through a large crystal which was then immersed in supersaturated liquor. The two surface entries were completely grown over, leaving the liquor-filled artificial inclusion clearly visible in the interior.

In an earlier paper[1], I reported that large crystals of several centimetres long might have as much as 0·4% of water inside the crystal, whilst normal granulated sugar appeared to contain rather of the order of 0·01%. Our research laboratories at Keston have now devised two different techniques for estimating internal water[2], and we know that even high quality granulated sugar may have up to 0·04% of internal water. It may, in fact, have more water inside than outside, and it should be remembered that only the latter would be included in our present accepted analytical methods. My early examination showed that Kandi crystals might vary very widely in their internal water (0·05 to 0·4%) and later examination under the microscope of a variety of smaller grained sugars, both raw and refined, confirmed my anticipation that they also would be found to vary greatly, though at a lower level (0·01 to 0·04%). What does this mean in terms of irremovable non-sugars ? Included water cannot readily be dried off, hence if we know the analysis of the mother liquor, and the percentage of water included within the grain, we can assess the amount of the various non-sucrose items held thus. The evidence I have to date, indicates that the colouring matter is all held thus, but that the internal ash is more often than not far higher than can be accounted for by internal liquor. Certain constituents of mineral matter are held in the crystal in the dry form, either having crystallized from the solution and then been grown-in, just like the sheets of metal I have already mentioned, or having been "enticed" into the lattice owing to some similarity of molecular form. This latter method is termed syncrystallization and most science students have experienced how multi-coloured crystals may be thus grown from solutions of different alums. In this case, the different materials are usually in massive layers, but it is equally possible for them to be of molecular proportion and quite invisible, even under the microscope.

I will quote some examples, to illustrate my point, of both refined and unrefined sugars and their respective mother syrups. I will assume 0·03% internal water, and mother syrup of three types, refined, raw beet and raw cane, to have the following analysis and Spekker colour (1 cm cell, 420 mμ).

	Refined Syrup	Beet Molasses	Cane Molasses
Sucrose	74·1	58	38
Invert	0·3	2	24
Ash	0·3	12	15
Organic	0·3	18	13
Water	25·0	10	10
Colour	20	20,000	100,000

If we assume 0·03% of water inside the crystal, we may easily compute how much ash will accompany it in each case, assuming the non-sugars to be in the same relative proportions in the included crystal.

	Refined Syrup	Beet Molasses	Cane Molasses
For Ash	0·00036	0·036	0·045
For Colour ..	0·024	60	300

Compare these figures with the amount of non-sugar found in crystals after efficient affining with pure sugar liquor :—

	Refined Sugars	Raw Sugars
Ash	0·001 up to 0·01%	0·04 up to 0·17%

Bearing in mind that by far the greater proportion of raw sugars are boiled from much higher purity

[1] *I.S.J.*, 1956, **58**, 246.
[2] HILL & GARDINER : *Analyst*, 1958, 143, **83**, 149; GARDINER & KEYTE : *ibid.*, 150.

syrups—molasses are only from the last recovery boilings—it will be seen that, in general, only a minor proportion of the ash is held in the syrup inclusions. It, therefore, must be held in some other manner. The proportion of colour held in the inclusions is much more significant, particularly in the low boilings, on account of the far higher ratio of colour to ash in the syrups.

I have already expressed my impression to date that the colouring matter is virtually confined to the internal mother liquor. Every coloured crystal I have yet been able to examine, when examined under sufficiently high magnification, exhibited the deep coloured inclusions dispersed in a comparatively colourless crystalline medium. In time it should be possible to check this opinion by analytical methods, but in the meantime I would gladly examine any crystals of sugar which appear to be uniformly coloured. I would still like to be able to follow up and test the evidence which led PAINE & BALCH[3], to advance the theory that the absorption of caramel was primarily determined by the electric charges of the caramel and the crystal. Dr. BUCKLEY[4] has had but little success in trying to find a dye which is uniformly dispersed in the sucrose crystal.

I think I should now describe my experience in exploring the interior, first of Kandi, then refined and raw crystals. One of my early surprises was on finding that some of the inclusions in dark coloured Kandi crystals were colourless, even though the rest were coloured, as one would expect. How could this be? The mother liquor could not have lost its colour surely. Then I realised the two types of inclusions had very different refractive indices, and finally, by watching several chosen crystals dissolving under the microscope, the answer became obvious: the colourless inclusions were air filled, not syrup filled. As a syrup filled inclusion was breached by the solvent a stream of the heavier dark syrup streamed downwards, whilst a colourless one under the same circumstances bulged like a balloon then broke away and the bubble rose rapidly to the surface of the solution. How could air have got in a crystal which had grown whilst surrounded by syrup? I am fairly confident that the explanation is simple, yet rather wonderful. The mother liquor was fairly saturated with air and as the sugar crystallized out, the solution of air became supersaturated and air bubbles were "nucleated" and grew on the surface of the growing crystal, there to be overgrown by the layer growth. Therefore, if you want air in your crystals, see that there is plenty in your feed to pans etc.,—and vice versa.

Having satisfied myself as to the above phenomena in large Kandi crystals, I then rapidly found the phenomenon to be normal with all crystals of sugar, even the purest of granulated, also that the amount of air so enclosed varied quite as much as the amount of internal water. Sometimes both air and syrup were to be seen sharing the same inclusion. Here then was a probable explanation of the varied figures which have been reported for the specific gravity of sucrose—from 1·58 to 1·60. We selected two crystals with maximum and minimum inclusion and found they had specific gravities of 1·582 and 1·594 respectively. It is probable that the melting point variations may similarly be affected to a considerable degree by the variation in internal water. Because of the unknown proportion of gaseous inclusion, it is wise not to assume that the crystals, which appear under the microscope to be most heavily included, necessarily contain a great deal of syrup. Tests for density in carbon tetrachloride—acetone, and the colour and appearance of the sugar after washing with pure saturated sugar solution should help to solve this easily.

(*To be continued*)

El Salvador Refinery.[5]—A new refinery near San Salvador should be finished by the middle of next year. It will be operated by Refineria Salvadorena de Azúcar S.A. and will have a production of 100 tons of refined sugar per day.

* * *

New German Sugar Factory.[6]—A fourth sugar factory is planned for Bavaria by the Verband der Fränkischen Zuckerrübenanbauer. It will be located between Schweinfurt and Bamberg, and will cost an estimated 40–50 million DM.

* * *

Brazil Production Estimate for 1958/59.[7]—The Brazilian Sugar and Alcohol Institute estimates 1958/59 sugar production at 48,290,000 bags (2,897,400 metric tons). In the 1957/58 campaign, Brazilian sugar production amounted to 2,662,218 tons as against 2,248,375 tons in 1956/57. Thus the Brazilian outturn has increased considerably during recent years. Domestic consumption is estimated at 2,040,000 tons; should this be correct, 857,400 tons of the 1958/59 sugar would be available for export. This compares with exports of 324,425 tons in the first half of 1958 and her quota under the new International Sugar Agreement of 550,000 tons.

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[3] ALEXANDER: Colloid Chemistry, Vol. 4, p. 154.
[4] Private correspondence.
[5] *Zeitsch. Zuckerind.*, 1958, **83**, 512.
[6] F. O. LICHT, *International Sugar Report*, 1958, **90**, (10), 4.
[7] F. O. LICHT, *International Sugar Report*, 1958, **90**, (10), 9.

Laboratory Vacuum Pan and Granulator

(*Concluded from page* 16).

after drying in the laboratory granulator. The screen test comparison shows good agreement between the laboratory and factory methods of sugar drying. A microscopic examination of the sugar dried by the two methods did not reveal any outstanding differences in crystal appearance.

The laboratory vacuum pan and granulator have been found to be very valuable in studies of the effects of processing variables on product quality. They have also been useful in locating difficulties in factory operations, and have been used for control tests.

The apparatus should be useful in other industries where crystallization under vacuum is used for obtaining small amounts of product.

The assistance of H. E. HALDEN, W. O. BERNHARDT, T. W. BAKER, and O. BONNEY of the Spreckels Research Staff is gratefully acknowledged.

SUGAR-HOUSE PRACTICE

A Straight Two-Boiling System. R. NOEL. *Rev. Agric. Sucr.* (Mauritius), 1957, **36**, 284–286.—In this system the A-massecuite of 95° Brix and 84 purity was built-up by boiling with syrup and A mother liquor on a C footing. Superheated water at 115°C was used for washing, giving a sugar of 98·7 pol and mother liquor of 56 purity. This was boiled to a final massecuite of 56 purity and gave a molasses of 33 purity, which drop (23 units) was less than the average of 24 ; a drop of 26 is possible, it is thought, with extension of the low grade battery of centrifugals. A final massecuite purity lower than 56 would cause graining difficulties.

* * *

Boiling of C-Massecuite and Washing with Thin Juice. R. KRAJEWSKI. *Gaz. Cukr.*, 1958, **60**, 13–14.—In reply to the proposal made by J. KURZEWSKI[1] to use thin juice for affination, the author points out with the help of a simple calculation that this would effect an economy of only 0·002–0·003% on beet and would give higher purity syrups and molasses and higher yellow sugar yield at the cost of white sugar production. The recommendation of the Central Sugar Industry Administration (Poland) for a C-massecuite of about 78 purity instead of 82 giving a molasses of < 65 purity is reiterated.

* * *

Dust Removal in Sugar Handling. R. STOCK. *Sucr. Franç.*, 1958, **99**, 44–47.—An "Airmix" apparatus installed at the Lieusaint sugar factory for dust collection is described and illustrated. The equipment comprises a venturi mounted vertically, at the top of which is a collection chamber. A liquid is introduced tangentially to the venturi through which the gas containing the impurities passes at 40 m/sec. The liquid film formed on the venturi wall is carried away by the gas stream. Atomization and eddying takes place to give intimate mixing of the droplets and impurities carried by the gas. The speed of the stream falls as it enters the wider tube section, and the droplets conglomerate to larger drops containing the impurities. The drops are directed into a rotary movement by vanes in the collection chamber ; they pass under centrifugal force to the wall and fall by gravity to the exit pipe. A return and fresh-water make-up system is described.

* * *

Experience with Fletcher Cooling Elements. M. MOHAN, C. CHANDRASEKRAN and S. N. A. CHARY. *Indian Sugar*, 1957, **7**, 581–585.—Tests with C-massecuite in a water-cooled crystallizer in which a Fletcher cooling element was installed showed : that the complete process cycle (cooling, "ripening" and reheating) lasted 20–24 hr compared with 25–32 hr using an air-cooled crystallizer ; that there was an increase in purity drop from massecuite to molasses varying from + 0·47 units to + 3·46 units for the 7 tests ; that there was a slight rise in the purity of the mother liquor of 0·025–0·35 units (dependent on relative temperature of massecuite and hot water) caused by the reheating of the massecuite from 45°C to 50°C. The costs of the installation are calculated to be recoverable in 2 seasons.

* * *

The Swiss Co-operative Societies Federation's Silo and Packaging Installations for Crystal Sugar in Pratteln. H. R. MÜLLER. *Zucker*, 1958, **11**, 69–75.—The Federation's installation at Pratteln which started operation in 1957 is described and illustrated. Sugar is unloaded pneumatically from the bottom of special railway silo-wagons of 24 metric tons capacity down a chute onto a horizontal belt conveyor and is taken by bucket elevator to the top of the concrete silo, where it is tipped onto one of eight chambers of 200 tons capacity each. From the chambers the sugar drops via belt conveyors and precision scales of English manufacture to the packaging station. This comprises two automatic S.I.G. machines of 65 1–kg bags/min capacity and a packaging machine with an electronic check weigher manufactured by CARL DROHMANN G.m.b.H. which packages 10 1–kg bags. The inside silo walls were painted with a resin paint, "Imerit V", to keep out moisture and only about 0·130 g of moisture was found to penetrate 1 sq. m. per hr. The packed sugar storehouse has a capacity of about 300 tons, stacked on pallets, each carrying 84 packs of 10 1–kg bags. The air-conditioning plant and colour schemes are described in detail. Neoprene containers of 2 cu.m. volume, containing 1600 kg sugar, are being used experimentally between London and Pratteln.

* * *

Piece Goods Conveying in the Sugar Industry. A. FACKELMEYER. *Zucker*, 1958, **11**, 95–99.—The various types of mechanism used to convey bagged and packaged sugar are reviewed and illustrated.

* * *

Rotary Pumps in the Sugar Industry. K. TSCHASKALIK. *Zeitsch. Zuckerind.*, 1958, **83**, 67–71.—The design and principle of the Roots Blower type of rotary pump are reviewed and its possible uses in the sugar industry discussed. Such applications include : as a blower for lime kiln gas, boiler waste gases in juice saturation, and for slightly compressed air for rotary filters and pneumatic conveyors ; for juice volume measurement, in which capacity it was first used in French factories after the war ; and as a drive for bucket wheels for automatic liming in defecation, and possibly also for automatic defeco-carbonatation. As pumps the machines can be used for clear liquors, massecuites, run-offs and molasses, and for continuous de-silting of the press-water settling tank. The use of the pump as juice meter in conjunction with an immersion electrode for automatic defecation has been successfully tested.

[1] *I.S.J.*, 1958, **60**, 204.

Transport Rationalization with Fork Trucks and Pallets. L. SCHERZER. *Zeitsch. Zuckerind.*, 1958, **83**, 71–74.—The use of wooden pallets and fork-lift trucks for storage of bagged products, etc. is reviewed and some methods of arranging the piles in a store-house suggested.

* * *

Modern Touch Speeds up Sugar Decolorizing. ANON. *Chem. Eng.*, 1958, **65**, 80–82.—The decolorizing plant at the St. Louis refinery of Industrial Sugars Inc. is described. Pittsburgh Coke & Chemical granular activated carbon is used in several 9-ft tall columns of 15,000-lb capacity, through which passes the defecated filtered juice before entering the ion-exchange columns. The carbon and resin beds are supported by "Neva-Clog" metallic filter medium. The spent carbon is passed via a storage hopper, where it is drained off, to the rotary kiln at 200 lb/hr by screw conveyor, and is removed from the kiln at 1400°F, after which it is quenched with 10 gal/min water. A centrifugal pump is used to return it to the columns. A column can be emptied in 40 min using this system. It is claimed that filtration rates are higher, that there is less sweet water, and that the juice entering the exchange columns has 80% less colour than with other decolorizing systems. Less than 5% make-up is needed for repeated regeneration of the carbon.

* * *

The Firing of Lime Kilns. F. W. TILLMANN. *Zeitsch. Zuckerind.*, 1958, **83**, 114–118.—Investigations were made into an accident in which two explosions occurred about 25 hr after firing of a lime kiln. The cause was found to be considerable CO formation as a result of insufficient draught; despite its low density, the CO filtered through to the bottom of the kiln. Certain measures to be adopted in the firing of kilns are suggested, as well as first-aid requirements, etc.

* * *

Boiling of Massecuite from Syrup of High Concentration. I. F. ZELIKMAN and YU. D. KOT. *Sakhar. Prom.*, 1958, (3), 12–17.—A method of boiling 1st product massecuites on syrups of up to 75°Bx is described. The syrup is evaporated in the vacuum pans by the normal method—full vacuum at 74–76°C—until crystallization, when a small amount of the syrup is pumped in and the temperature raised to 83–84°C in 6–10 min and kept at this level until complete crystallization. Trial boilings have proved satisfactory and suggestions are made regarding alterations to existing evaporation and boiling schemes.

* * *

The Use of Hydrocyclones in the Sugar Industry. T. M. LES'KIV. *Sakhar. Prom.*, 1958, (3), 17–23.—Factory trials were carried out on thickening unfiltered 1st carbonatation juice in hydrocyclones. The mud solids content reached a maximum (about 5 times the original) with a feed-pipe pressure of 8 atm. at 90°C. As the clear juice had a solids content of 1·1% in the form of muds, the particle diameter being less than 4μ, further tests were made with two-stage thickening. The diameter of the second-stage hydrocyclone was reduced and the temperature of the suspension raised before treatment. Under this scheme the suspension is thickened in the first cyclone and the overflow goes via a tank to the second cyclone. The thickened underflow from the second cyclone is returned to the 1st cyclone, while the clear juice from the 2nd cyclone goes to a tank and thence to process. At a feed-pipe pressure of 8 atm. and 105°C the mud solids are increased from 1·4% by weight to 21%, the thin juice containing 0·45% suspended solids, which do not settle for some days.

* * *

Sealing, Drives, Anti-Friction Bearings. J. M. BRYANT. *Sugar J.* (La.), 1958, **20**, (8), 8–12.—Bearing and drive seals are discussed in general and the various types of seals described and illustrated with a list of applications for which they are inadequate.

* * *

Anion-Exchange Method of Making Alkaline Process Water in Refined Sugar Production. S. Z. IVANOV. *Sakhar. Prom.*, 1958, (3), 35–36.—The use of anion-exchange resins is recommended for converting some of the lime salts present in the water into alkali sufficient to raise the pH to 7·5–8·0. pH control is better with this method than with addition of alkali to water.

* * *

Non-Automatic Scheme for Condensate Withdrawal. M. P. SOKOLENKO. *Sakhar. Prom.*, 1958, (3), 52–53.—The non-automatic condensate removal scheme at Bichursk factory is described and illustrated.

* * *

Uniform Calculations for Heat Exchangers (Heaters) in the Sugar Industry. S. PITTAUER. *Listy Cukr.*, 1958, **74**, 61–64.—Sample calculations are given for heat transmission determination in gas-liquid and liquid-liquid heat exchangers.

* * *

Construction and Materials of Hydrocyclones and Further Tests in the Cane and Beet Sugar Industry. K. CÍHAL. *Listy Cukr.*, 1958, **74**, 65–68.—The construction of hydrocyclones is discussed with 14 references to the literature. The hydrocyclone designed by K. BAUMANN (East Germany) for separating impurities from chalk, kaolin and clay is described. Use of a 4 mm surface layer of rubber on metal parts is advocated to extend the life of hydro-cyclones. Porcelain hydrocyclones are considered suitable for lighter work. The various uses to which hydrocyclones have been put, e.g. sand removal from milk-of-lime and 2nd carbonatation juice purification in Germany, are discussed.

* * *

Some Notes on Cane Sugar Factory Control. K. DOUWES DEKKER. *Comm. Sugar Milling Res. Inst.* (Natal), 1958, (40), 27 pp. + tables and graphs.—Factory control is discussed generally and boiling house

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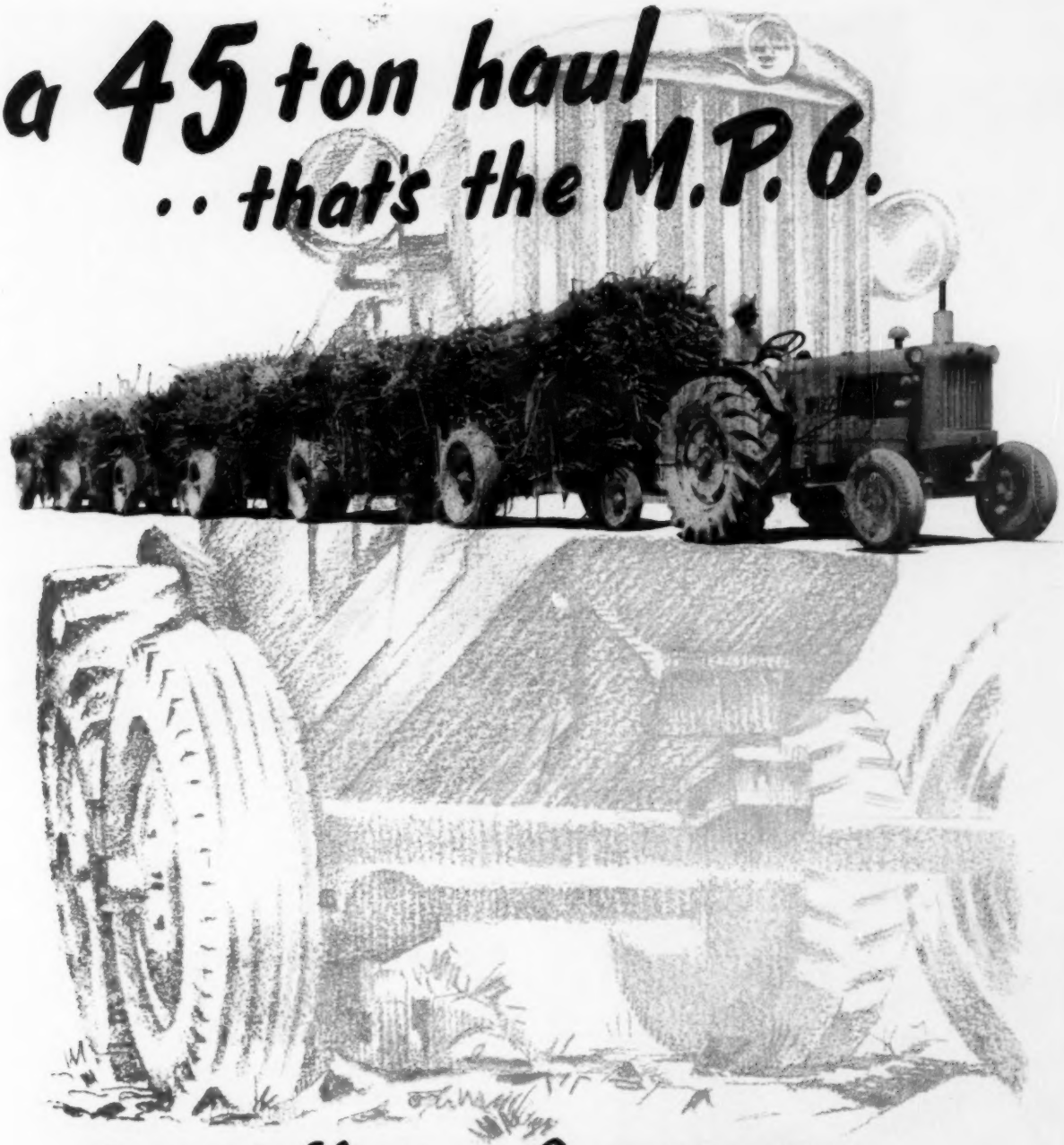

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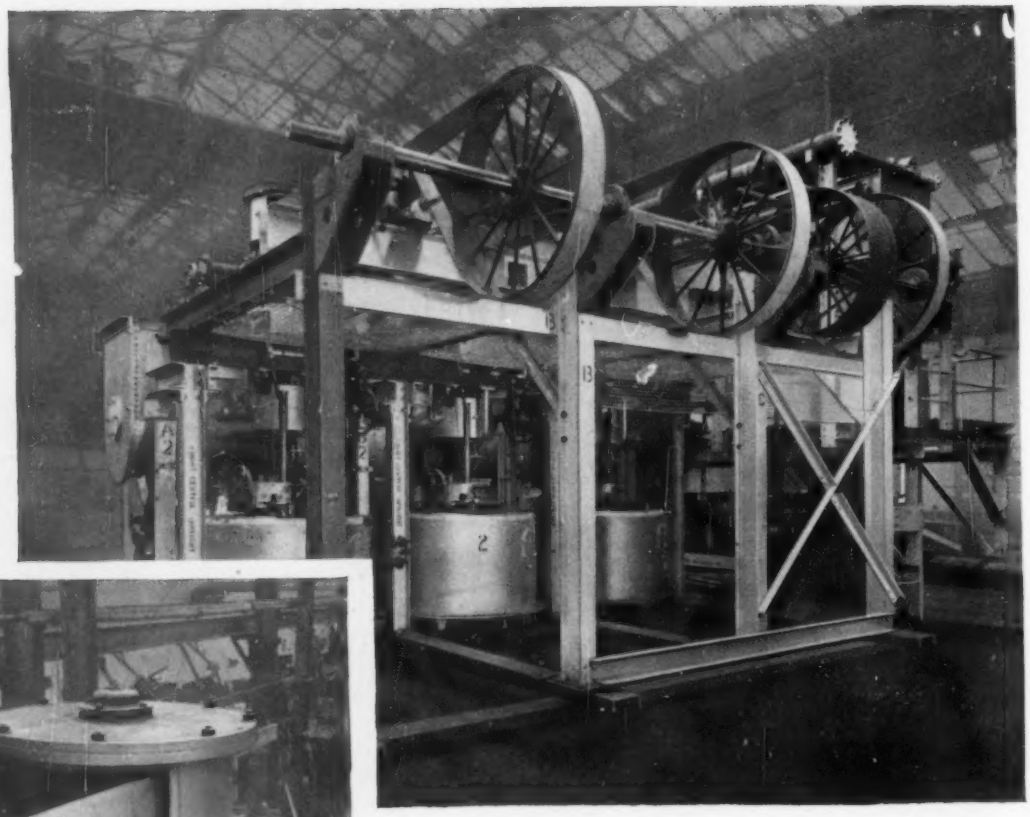

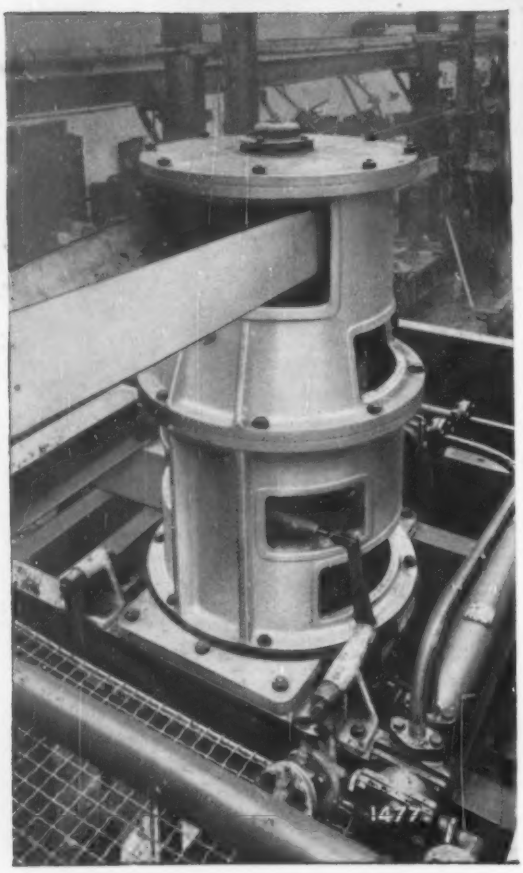

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and control in particular. The adoption of pure crystallized sucrose as the Natal Standard Sugar for determination of crystallized sucrose content of sugar is not considered advisable as new figures calculated would not be comparable with the old figures. A table of factors is given for the conversion of sugars of 94–100 pol into the equivalent weight of crystallized sucrose and 96° sugar. The formula for conversion to crystallized sucrose is: $X = 1{\cdot}57$ pol—57·0, and for conversion to equivalent weight of 96° sugar X is multiplied by 1·0670. Milling control as practiced formerly in Java and the use of experimental mills in Queensland are discussed. A more detailed system of control is required, based on a generally acceptable theory of milling. Some of the basic factors controlling juice-fibre separation are reviewed and results are tabulated for increasing weight of fibre/cu.ft. escribed volume. The installation of a rev.-counter on each mill is advocated, in order to calculate the average peripheral speed and thus the escribed volume. The determination of fibre density is discussed. From the tabulated results referred to above, it is shown that the only factor controlling juice loss is fibre volume (or weight) as a proportion of the escribed volume of the mill. Moisture % bagasse and % volume occupied by juice are shown to decrease almost linearly as the weight of bone-dry fibre/cu.ft. escribed volume increases, the effect of fibre weight on juice loss % bone-dry fibre decreasing at higher fibre throughput. Mill data from Java 1st mills are compared with the theoretical calculations; the data do not show good correlation with the degree of filling of the mill opening with fibre. The actual losses are higher than the calculated, the difference increasing with increased filling. Re-absorption (squirting) is considered the cause and comparison of re-absorption for a given mill with the re-absorption values shown by a curve of Java mill figures is recommended as a guide to performance. It has been shown that a crusher before a 1st mill tends to reduce re-absorption, while it has been suggested that peripheral speed and roller grooving are also important factors, although these must be further investigated.

* * *

Control of Foaming in Molasses Tanks. M. J. PARSONS. *Sugar News* (Philippines), 1958, **34,** 21–23.—Three methods of molasses foam control are described. In the first, the foam flows down an overflow duct to a cement trap, which is connected by a pipe to the main sump. Agitation of the foam in the duct converts it back into molasses and this flows via the sump back to the storage tank. Under the second scheme air is injected into the tank through 8 branch pipes connected by a pipe running around the tank circumference. The air is admitted through one pipe at a time. A 700 r.p.m. compressor is used. In the third method calcium hypochlorite in the form of an aqueous solution is added to the molasses at 0·0073 kg/per metric ton of molasses, yielding 5 p.p.m. available chlorine per million parts molasses. Injection is through an air-injection pipe system as described above.

Possibilities of Electronics in the Sugar Industry. J. F. DUSAILLY. *Ind. Alim. Agric.*, 1958, **75,** 121–122.—The possible applications of electronics in the sugar industry which are mentioned include: beet-slicer speed control through the continuous belt cossette-weigher; automatic carbonatation control by means of pH and temperature regulation; automatic evaporation control by means of a servo-mechanism actuated by variations in a large number of parameters; continuous boiling control; massecuite pump speed control; and automatic control of sugar drying by measurement of sugar moisture content.

* * *

Sugar Factory Stock Taking. A. G. KELLER. *Sugar Journal* (La.), 1958, **20,** (10), 21–23.—Taking stock of the material in process in a sugar factory and making a sucrose balance are discussed.

* * *

The Effect of Reducing Sugar Content and Relative Humidity on the Storage of Soft-Sugar Product. S. HONDA and Y. KAMEI. *Seito Gijutsu Kenkykaishi*, 1956, 1–6; through *Chem. Abstr.*, 1958, **52,** 765.—The effects were studied with soft-white superior sugar, soft-white medium sugar and soft-yellow sugar polyethylene, paper or cotton bags as packing material. When the packed sugar products were stored at low humidity, more caking and loss of moisture occurred. The polyethylene bag had excellent water-proof characteristics and the soft sugar packed in it did not cake at 60% relative humidity. The waterproof effectiveness of the three materials decreased in the order: polythylene, paper and cotton. When a 10 g sample was held at <75% constant R.H., soft sugars reached a state of moisture equilibrium after 50 hr at 25°C. The soft-white superior grade tests showed a proportional relationship between reducing sugar content and equilibrium moisture when the R.H. was <75%. In the soft-white medium sugar, having 1·9% reducing sugar, 1·7% moisture and 0·2% ash, the equilibrium R.H. was 75% at 25°C, but in the soft-white superior, having 0·1% reducing sugar, 1·7% moisture and 0·03% ash, the equilibrium R.H. was 85% at 25°C. It is suggested that polyethylene packings should be used for the prevention of caking and moisture absorption by stored sugar, and that the atmospheric humidity should be maintained at the equilibrium R.H. for the sugar products in warehouse storage.

* * *

An Approximate Equation for the Mass Crystallization Rate of Sugar. P. V. GOLOVIN. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1956, **16,** 9–15; through *S.I.A.*, 1958, **20,** Abstr. 179.—On the basis of Fick's law, the following expression is derived from the crystallization of a supersaturated sugar syrup:

$$\log \frac{S_0}{S} = \frac{D\phi n\,(1-p)\gamma\tau}{2{\cdot}3\varepsilon a}$$

where S_0 and S are the sugar contents of the supersaturated and saturated syrups respectively, in kg/100 kg; D is the molecular coefficient of diffusion of

sucrose in sq.m./hr; ϕ is the surface area of a single crystal in sq.m.; n is the number of crystals per g; p is the fractional sugar loss (uncrystallized sugar in the intercrystalline solution); γ is the density of the supersaturated syrup in g/cc; τ is the time in hours; δ is the thickness of the diffusion film on the crystal in m; a is the ratio of the weight of the boiled massecuite to the weight of the contained sugar, in kg/kg. The diffusion coefficients of sucrose under production conditions are estimated to be: for 1st massecuite, $D'_1 = 0{\cdot}500 \cdot 10^{-6}$; for 2nd massecuite, $D'_2 = 0{\cdot}45 \cdot 10^{-6}$; at the end of boiling $D = 0{\cdot}428 \cdot 10^{-6}$; ϕ for 1st and 2nd massecuites is estimated at 0·0141 sq.cm. and 0·00221 sq.cm. respectively. Log S_o/S for 1st and 2nd massecuites is 0·5145 and 0·2867, respectively, and p is 0·305 and 0·5167 respectively. The film thickness is; for 1st massecuite, 0·068 mm; for 2nd massecuite, 0·23 mm; for 2nd massecuite after cooling to 30°, 0·45 mm. These values (based on typical factory data) are substituted into the above equation to give a series of values of S_o for different τ, and S_o is plotted against τ to give a descending curve.

* * *

Determination of the Crystallization Rate of Sucrose in Sugar Syrup at Temperatures of 70°, 80° and 90°C. A. A. GERASIMENKO and P. V. GOLOVIN. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1956, **16,** 17–19; through *S.I.A.*, 1958, **20,** Abstr. 180.—Crystallization rates of supersaturated solutions made from a syrup containing 68% solids, 63·3% sugar, and of 93·09% purity were determined at 70°, 80° and 90° as functions of the coefficients of supersaturation, by the weighing method. The crystallization rate increased with temperature for a given coefficient of supersaturation, and increased with the latter at constant temperature.

* * *

Corrosion of Steel Tubes of Evaporators in the Sugar Industry. V. BOCIOAGA, C. BARCIU and A. TATARLA. *Lucrarile Inst. Cercetari aliment.*, 1957, **1,** 57–82; through *Chem. Zentr.*, 1958, **129,** 283.—Tubes of different manufacture were tested for corrosion (weight loss in g/sq.m./hr) on keeping in sugar juices, syrups, molasses, or distilled or drinking water. The effects of pH, syrup concentration, molasses impurities, temperature and surface conditions were also examined. A cold-drawn phosphated steel tubing with a smooth, hard surface was by far the most resistant.

* * *

Corrosive and Anti-Corrosion Protection in the Sugar Industry. G. MANTOVANI. *La Metallurgia Italiana*, 1957, **49,** 669–672; through *S.I.A.*, 1958, **20,** Abstr. 195.—The possibility of applying cathodic protection to vessels containing sugar solutions has been tested in the laboratory. Sheets of iron, 50 × 50 mm and 4 mm thick, were suspended for 86 hours in sugar solutions of 10, 20, 30, 40 and 50% concentration at 25°, 40° and 80°C, and anodes of magnesium or zinc (15 × 15 × 4 (or 6) mm) were attached. The electrical conductivity of the solutions was measured at intervals, and the iron, magnesium or zinc contents were measured at the end of colorimetric and gravimetric methods; the reducing sugars content was also determined. The results, which are tabulated, show that the rate of corrosion of the iron was reduced to very small proportions by the cathodic protection. The dissolution of magnesium or zinc has previously been shown to have no deleterious effect upon the crystallizability of sucrose, and the salts do in fact check the formation of reducing sugars, probably owing to the stabilization of the pH; magnesium is better than zinc in this respect. The requisite dimensions of the anodes needed for full-size plant would have to be determined by factory tests.

* * *

Determination of the Electrokinetic Potential of Suspensions of Turbid First Carbonatation Juice. R. KOHN and J. VASÁTKO. *Zucker*, 1958, **11,** 161–166. *See I.S.J.*, 1958, **60,** 176.

* * *

Principles of Evaporator Station Automatic Control. S. ZAGRODZKI. *Gaz. Cukr.*, 1958, **60,** 105–108.—The fundamentals of evaporator station automatic control are reviewed with 31 references to the literature. A control system for a 2400 tons/day factory is suggested, in which vapour and juice feed, juice level and density, incondensable gas removal and condensate flow are automatically controlled. The pressure and temperature of the vapour in the 1st effect are raised and those in the juice chamber of the last effect lowered automatically, while those in the 2nd effect, by which the other parameters are determined, remain constant. Thus the greatest possible difference in the temperature of incoming and outgoing vapours is obtained by regulating the juice feed valve. The system is compared with the Hartmann & Braun system.

* * *

Tests on 1st Carbonatation Automation. R. DERKOWSKI. *Gaz. Cukr.*, 1958, **60,** 110–112.—The installation at Kruszwica for determination of the optimal conditions of 1st carbonatation automatic control is described with diagrams. Defecation was carried out in a vessel in which the upward flowing juice was stirred by an agitator arm. Gassing of the juice in the saturater, which comprised two juice vessels, was controlled by a special Billman alkalimeter-regulator apparatus. This consisted of a servo-mechanism and a cylinder housing a piston. Electrodes were located in the juice pipes. Once an alkalinity of 0·007% CaO was reached the conductivity change was transmitted to the diaphragm of the servo-mechanism, which in turn forced the piston downwards. The piston was connected indirectly to a special Billman valve in the gas pipe leading to No. 1 vessel, and depression of the piston closed this valve. A graph shows good correlation between the number of alkalinity readings as a function of the CaO content using manual control and that using automatic control. The valve became blocked after 21 days, however, and scale formed on the electrodes.

Drying-out of Sugar Beet. M. DRACHOVSKÁ and K. SANDERA. *Listy Cukr.*, 1958, **74**, 29–35.—Weight losses in stored beet are reviewed with 16 references to the literature, and calculations made of the effect of size and shape of beet piles on the weight changes. In a conical pile of about 280 tons of beet, the sides of which are protected with earth and the top covered, e.g. with mats or layers of earth so that the wind cannot penetrate, the daily surface losses can be reduced from 0·4% (as in field piles protected with brushwood) to about 0·048% of the total weight of beet.

* * *

Formula for Calculating Rotary Diffuser Efficiency. V. M. VOLOKHVYANSKII. *Sakhar. Prom.*, 1958, (3), 26–29.—The formula derived by E. T. KOVAL' for rotary diffuser efficiency[1] is criticized on the grounds that the value for K, a constant, given as 0·074 in the formula ($A = 0{\cdot}074\ D^3 \frac{\gamma n}{1 + 2\beta}$), is in fact not correct for all cases. A new formula has been proposed, viz :

$$Q = \frac{D^2 \cdot L \cdot K \cdot q \cdot 60 \cdot 24}{4t}$$

where Q = diffuser capacity in tons beet/day, D and L = drum diameter and length respectively (meters), K = 'filling' coefficient, q = cossette charge in tons/cu.m. of the working space, and t = retention time in min. The use of this formula, which is only applicable to double-scroll diffusers, is explained with the aid of sample calculations. E. T. KOVAL'S objection to the formula is explained as due to misunderstanding.

* * *

New Method of Checking Beet Cossette Quality. P. S. SICHEVOI. *Sakhar. Prom.*, 1958, (3), 30–32.—The author replies to criticism of his method of calculating cossette quality. He emphasizes the need to evaluate the thickness and uniformity of thickness of the cossette, the fines content, compressibility and permeability, as opposed to the usual method of characterizing the external properties of the cossette. Tests on the permeability of a column of cossettes showed that this was greater with flat than with V-shaped cossettes and that at 80°C this decreases in 40 min by 2½ times, e.g. from 50 to 20 cu.m./sec. A graph is drawn showing the changes in permeability during the campaign.

* * *

The Effect of Maleic Hydrazide on the Keeping Quality of Factory and Mother Beet. P. N. SHEMYAKIN, N. K. SEMENOVA and L. F. USHKALOVA. *Sakhar. Prom.*, 1958, (3), 32–35.—Tests were carried out on the spraying of beets 7–26 days before harvesting with maleic hydrazide, and diethanolamine, triethanolamine, potassium and sodium salts of maleic hydrazide. Germination of stored beet was greatly reduced by 0·3–0·6% solutions, and was almost completely prevented by 1–3% solutions. Sugar losses in beet sprayed with 0·3, 0·6 and 1·0% solutions were generally lower than in the control, while they were somewhat higher when a 3·0% solution was used. The resistance of stored beet to spoilage was lowered by spraying with maleic hydrazide and treatment is therefore not recommended for factory beet. Minimum germination results from spraying with 0·6% solution and treatment of mother beet is therefore advocated, where it will cause increased seed production. Confirmation of these results is deemed necessary.

* * *

New Devices for Unloading Beet from Trucks. V. V. POZDNEV and I. A. POLUEKTOV. *Sakhar. Prom.*, 1958, (3), 43–45.—A tipping platform for unloading beet from vehicles of up to 4 tons capacity and a mobile conveyor equipped with a bin are described in detail with illustrations.

* * *

Tests on the Olier Continuous Diffuser. S. ZAGRODZKI, J. DOBRZYCKI and H. ZAORSKA. *Gaz. Cukr.*, 1958, **60**, 71–77.—Tests carried out at Lodz Polytechnic in 1956 on an Olier diffuser of pipe cross-section 2·15 sq.m. and effective length 74 m are discussed in detail with 37 references to the literature. The results of juice analysis show that even with substandard beet (the tests were held on 14th–17th December) the performance is comparable to the best performance of a Robert battery diffuser. Losses for the first two days were 0·53% and for the third day 0·77%.

* * *

Laboratory Juice Purification Experiments with return of Over-Saturated Juice. Z. I. TÓTH and K. MAGYAR. *Cukoripar*, 1957, **10**, 208–212; through *S.I.A.*, 1958, **20**, Abstr. 115.—The Wiklund method was tested on Hungarian beet juices, with pre-defecation at 40°C with 0·2–0·3% of CaO, added gradually, and return of oversaturated juice at 60°C, heating the pre-defecated juice to 80°C, liming to 1·5% CaO alkalinity, and saturating to 0·07–0·09% CaO, with part over-saturated to 0·02% CaO alkalinity. Better results were obtained with 100% juice return than 75% return. Sedimentation times were measured in a glass cylinder, and filtrability was determined by Silin's and Vukov's methods. Results are tabulated in detail. The filtrability rate could be increased by a factor of 3 to 5, and settling times were also improved.

[1] *I.S.J.*, 1958, **60**, 22.

Danish Sugar Industry and Production. 11 pp; $5\frac{3}{4} \times 8\frac{1}{4}$ in. (AB. De danske Sukkerfabrikker, Copenhagen, Denmark.) 1958.

This little booklet, in English, describes the development of the Danish sugar industry and its present organization. The Danish Sugar Corporation, a private Company, produces 85% of the country's sugar, the remainder coming from the Nykobing cooperative factory. The beet contracting and price arrangements are described, and also the part played by the Corporation in improving beet agriculture.

The factory equipment and processes are described and some data given for the past three campaigns. The selling arrangements, and other activities of the Corporation are described, the latter including beet seed production, farming, and sale of D.d.S diffusion and pre-liming equipment, etc. A map of Denmark is given showing the location of the factories and refinery, juice stations, agencies and warehouses, and the Experiment Station.

* * *

L'Industrie du Sucre de Cannes. (The cane sugar industry). G. ESTORD. 628 pp ; $6 \times 9\frac{1}{2}$ in. (Dunod Editeur, 92 Rue Bonaparte, Paris 6e, France.) 1958. Price : Frs. 7900.

This work is in six sections covering, respectively, generalities (sugar-bearing plants and a comparison of the beet and cane sugar industries), the sugar cane (botany, anatomy, conditions of growth, metabolism, nutrition, etc.), cane cultivation (soils—structure, chemical properties, microflora, erosion, drainage, and improvement ; cane planting, fertilization, harvesting and supervision), industrial terminology (definitions of terms used in the cane sugar industry), properties of the components (physical and chemical properties of sucrose, glucose, levulose, starch, pigments, etc.), sugar factory (juice extraction, clarification, evaporation, crystallization and auxilliary equipment), the laboratory (techniques and analysis of sugar factory products) ; factory auxiliaries (refinery, by-product utilization and general organization and layout of a sugar factory), and considerations on the economics of the sugar factory. There follow a number of tables of e.g. Herzfeld's sucrose solubility data, Blatner's tables of milk of lime density, etc., a conversion table for various units, a bibliography and index. The book covers such a wide field that it would not be possible to give a thorough treatment of all aspects and it is also not as up to date as one would expect with a book published in 1958. A further drawback is the number of misspellings which occur and the rather high price. Nevertheless, there is no other work available in the French language which covers the scope of M. ESTORD's book, and it will undoubtedly be a useful aid to those whose knowledge of French is greater than that of English.

* * *

F. O. Licht's Internationales Zuckerwirtschaftliches Jahr- und Adressbuch 1957/58. (International Sugar Economic Year Book and Directory.) 362 pp ; $8\frac{1}{4} \times 11\frac{1}{2}$ in. (F. O. Licht K.- G., P.O. Box 90, Ratzeburg, Schleswig-Holstein, Germany.) 1958. Price : 55s. 6d.

The 1958 edition of this valuable reference book is in very much the same form as the previous edition, although a few minor changes are evident. Brazil, Iraq, Yemen, Jordan and Saudi Arabia are now included in the countries having sugar import and/or export companies, while Malaya has dropped out. In the Atlas section are maps giving the sugar factory locations in Florida and Louisiana and in Mexico. Italian Somaliland is now represented among the cane sugar-producing countries by one small factory. A report on the West German sugar machinery industry is made by Dr. W. DÖRFELDT of the Berlin Institut für Zuckerindustrie, and Dr. W. STEUDEL reports on recent advances in knowledge of beet virus yellows.

* * *

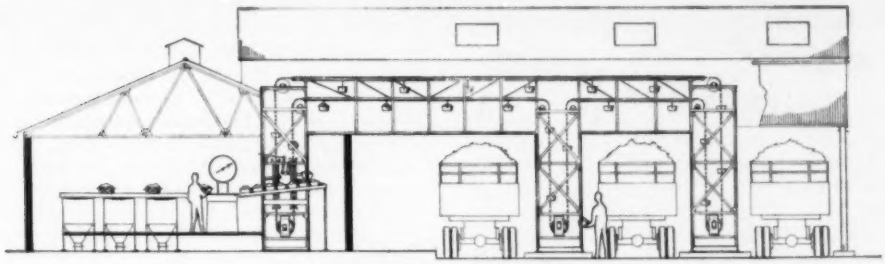
The South African Sugar Year Book, 1957-58. 275 pp ; $8\frac{1}{2} \times 10\frac{1}{2}$ in. (The South African Sugar Journal, 7th Floor, London Assurance House, 321 Smith Street, Durban, Natal.) 1958. Price : 10s. 0d.

The 28th edition of this useful guide to the sugar industry of Natal and Zululand is divided, as before, into six sections—Special Articles, Industrial Reviews and Articles, Reference, Statistical, Natal, and Zululand Sugar Milling Enterprises, and Sugar Milling Enterprises in Neighbouring Countries, with all data brought up to date. In this last section is found a newcomer, Swaziland, which is represented by the Mhlume (Swaziland) Sugar Co. Ltd. and the Ubombo Ranches Ltd., the former planning to crush in 1960 and the latter already crushing at one factory with a further factory planned. The industrial reviews include the Annual Reports of the South African Sugar Association, the Cane Growers' Association, and of the S.M.R.I. as well as the Annual Summary of Laboratory Reports. The presentation of the information throughout the book remains unchanged. A feature of the new edition are a number of attractive pictures in colour, illustrating various activities in the sugar industry of South Africa and neighbouring countries.

[1] *I.S.J.*, 1957, **59**, 223.

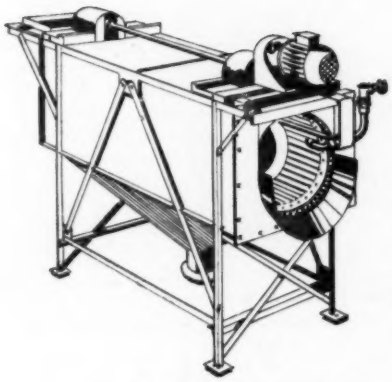
TAREHOUSE EQUIPMENT

AS SUPPLIED TO THE BRITISH & EIRE SUGAR CORPORATIONS AND TO MANY OF THE SUGAR BEET SEED GROWERS



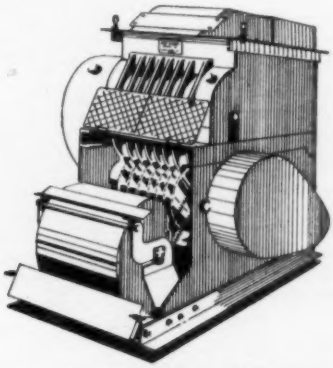
SAMPLES CONVEYOR

Combining regulated feed of samples direct from lorry, and safety by elimination of road crossing by the operators



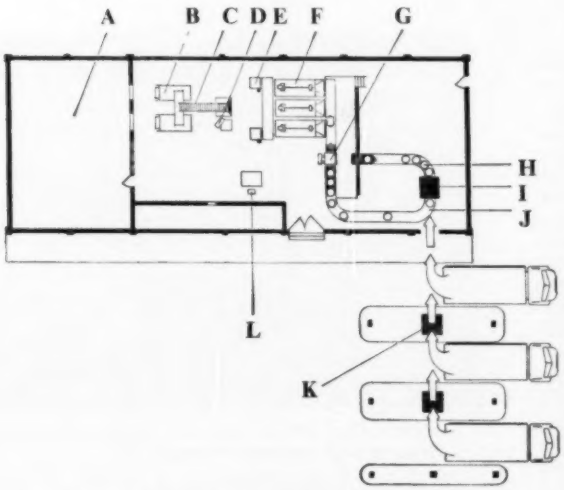
SPRAY WASHER

Using water at 90 lb. p.s.i. ensures clean roots
20 samples each of 50 lbs. handled per hour.
Speed of drum easily variable between 3 and 22 r.p.m. to suit type and quantity of dirt adhering to sample roots.



MULTIPLE SAW

Takes up to 100 lbs. of roots, handling a 30 lb. sample in 25 secs. and producing a representative sample of brei.



A TAREHOUSE LAYOUT

– handling 650 samples per day.

A *Laboratory*
B *Multiple Saw*
C *Elevator*
D *Scales (Clean)*
E *Topping Tables*
F *Spray Washer*
G *Scales (Dirty)*
H *Empty Pannikins*
I *Unloading Leg of Samples Conveyor*
J *Full Pannikins*
K *Loading Leg of Samples Conveyor*
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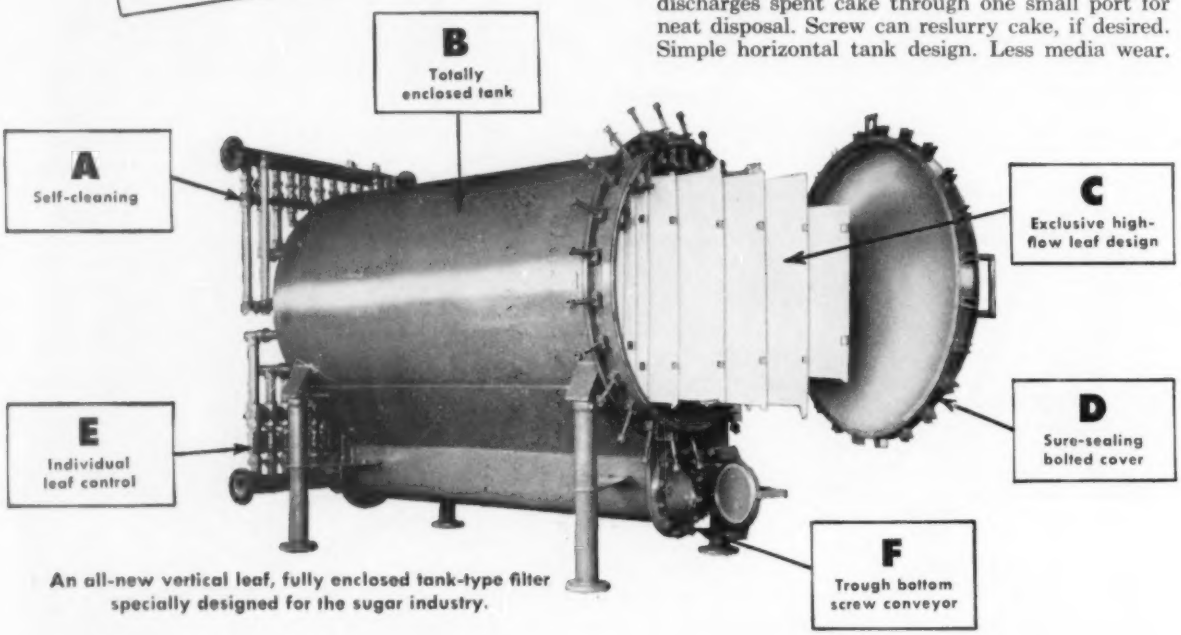
EXCLUSIVE OPERATING ADVANTAGES

Greater Clarity Control—Sight glasses, sample cocks and individual control valves for each leaf provide continuous clarity control. Should any leaf not function properly, it may be shut off without interrupting operation.

Minimum Manpower Required—A single non-skilled individual is capable of operating a large battery of RSC filters including filter aid addition, cleaning, precoating and supervising.

Faster Cleaning, Easier Maintenance—A 560 sq. ft. Model RSC can be cleaned in 10-15 minutes (30-45 minutes total down-time). Leaves are sprayed clean individually. Screw conveyor in trough bottom discharges spent cake through one small port for neat disposal. Screw can reslurry cake, if desired. Simple horizontal tank design. Less media wear.



An all-new vertical leaf, fully enclosed tank-type filter specially designed for the sugar industry.

Exclusive Design Features

A Internal sprays sluice filter. Can be independently valved for individual operation under low pressure conditions.

B No leaking, dripping or air-borne contamination. Assures a neat filter station with clean, sanitary service. Filter may be insulated to minimize heat loss. Can be installed in low headroom, small floor space areas.

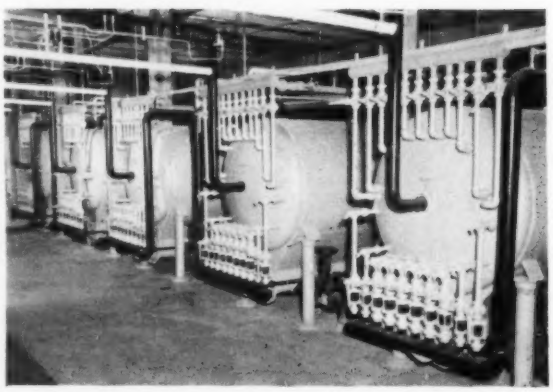
C Vertical rectangular leaf design assures maximum flow per filtering area and even precoating. Unexcelled rigidity and durability. Hung on roller carriages for easy individual inspection or removal, no bolts or fastenings. Self-sealing in filter. Stainless steel leaves covered with long-life synthetic cloth or stainless steel wire screens.

D Bolted cover on double-hung hinge provides full access to interior without leaf removal. Hydraulic quick-opening cover optional.

E Individual plate outlet control valves, sight glasses and sample cocks. Any plate or plates may be shut off without removing filter from service.

F Trough bottom with screw conveyor discharges cake neatly and quickly without opening tank. Cake can be reslurried if desired.

SIZES UP TO 1020 SQ. FT. OF FILTERING AREA



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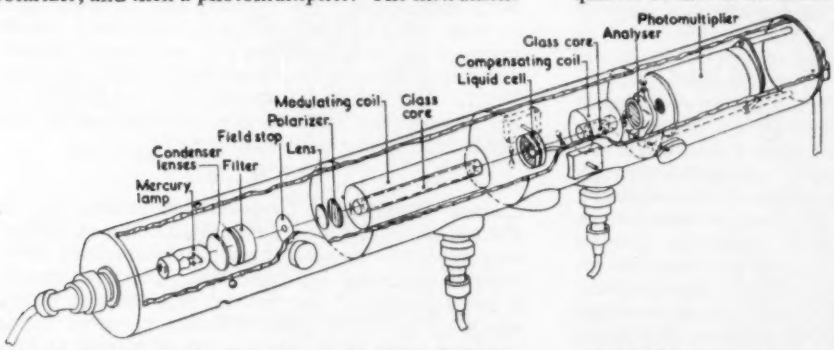
Laboratory Methods and Chemical Reports

Automatic Recording Saccharimeter. J. W. GATES. *Chem. & Ind.*, 1958, 190–193.—In the equipment illustrated, a miniature mercury lamp is the light source which by means of the condenser lens system and Wratten 77A light filter provides the green light of 546 mμ used. This passes through a polarizing filter ("Polaroid HN 20") and through a 10 cm-long rod of special DEDF glass (Chance 030181) which forms the core of an electromagnet carrying A.C. of mains or suitable low audio frequency. The alternating magnetic field induces an optical rotation in the glass which alternates in direction so that the plane of polarization is modulated and swings in step with the field over an angle of 3° on either side of its un-modulated direction. The beam then passes through a liquid cell containing the sample liquid the optical activity of which rotates the unmodulated direction by a certain angle, the modulation remaining at 3° on either side of this. The beam passes through a second glass rod, 5 cm long, which is the core of an electromagnet carrying D.C. so that the optical effect of the sample liquid can be counter-balaced by adjusting the current to the electromagnet. The beam encounters the analyser, also a "Polaroid" filter, set in the crossed position with respect to the polarizer, and then a photomultiplier. The instrument



is balanced when the rotation of the sample is exactly compensated by means of the D.C. electromagnet and the maximal light intensities of the modulation cycle are equal. This is achieved by feeding the photo-multiplier signal to a filter circuit which removes the first harmonic giving a signal corresponding to the modulation frequency. This is amplified and rectified, the output then being smoothed and further amplified. Its sign (+ or —) indicates the direction of the lack of rotation balance and it is therefore applied to the compensator electromagnet coil, providing negative feedback so that the saccharimeter operation can be made largely independent of fluctuations in the power supplies or brightness of the lamp. With the proper precautions the current flowing in the compensator electromagnet is then proportional to the rotation produced by the sample in the liquid cell, and may be used to work a chart recorder or other control gear. The saccharimeter is capable of detecting a change of less than 0·001° and could be applied in two forms: one measuring sugar concentration from 0–100% to 0·2% or over a range of 1000 p.p.m. with a sensitivity of 2 p.p.m.

* * *

Pulp Pressing Research 1957/58. R. CAROLAN and C. O'DONOVAN. *Irish Sugar Co. Ltd. Research Lab. Rpt.*, 1958, (38), 22 pp.—Experiments on double pressing of pulp and on the use of $CaCl_2$ are described. It is found that double pressing in a laboratory press with an intermediate mixing of the pulp lowered the water content by 4–5% from say 87% obtained with single pressing over the same total time. Addition of 0·05% $CaCl_2$ between pressings lowered the moisture further by a further 1% approximately. Little was gained by allowing the pulp to stand for a time before the second pressing. In factory press tests, the improvement on double pressing was only a quarter of that in the laboratory ; various explanations are offered. Factory trials with two pressings were carried out and the results examined from an economic viewpoint. Apart from three results which were considered anomalous, the average drop in moisture content was 1·2% which corresponds to a saving of £69 per day for a 3000-ton Irish factory using an oil-fired dryer. Probably eight more presses would be needed, however, at a cost of £2000 each. Factory tests on $CaCl_2$ addition showed an improvement which at 0·8% lower water content, using 0·06% $CaCl_2$ would give a net return of £10 per day ; the second pressing, however, requires the doubling of the press installation. Low-pressure (1 atm) treatment in the laboratory press was found to give almost as good results as higher pressures (2 atm), since the first portions of water are easier to expel than the last. To examine how much sugar, which would otherwise be lost in waste waters, is recovered by returning them to diffusion, some diffusion water was defecated and carbonated. Analysis of the product indicated that 54–63% of the sugar content would be recoverable as white sugar.

Method of Counting the Crystals Contained in a Given Weight of Massecuite. M. ROCHE. *Sucr. Franç.*, 1958, **99**, 83-84.—The sample is spread thinly and evenly on a weighed microscope slide and this reweighed. A small part of the sample is photographed with an accurately known magnification and the whole slide photographed without magnification. From the weight of the photograph of the slide (of known area) and the weight of the cut-out photograph of the sample, the surface of projection of the latter may be calculated. From the surface area of the enlarged photograph, its known magnification, and the number of crystals therein (which are counted), the number of crystals per unit area (unenlarged) may be calculated and hence the number in the whole sample. Since the weight is known, the number of crystals per unit weight can be calculated. It is emphasized that weighing should be rapid because of water loss.

* * *

Investigation of the Swelling Capacity of Various Types of Beet Pulp with regard to Drying. R. LOSERTH. *Zucker*, 1958, **11**, 138-143.—Investigations of the swelling capacity of normal beet pulp and of "Sepa" pulp, produced by spraying the normal pulp with "Sepa homogenisate", were made using the apparatus described previously[1]. Graphs were drawn showing the values of Q_s (specific swelling capacity) and weight in g/250 cc as functions of the dry solids content of the sprayed pulp during normal drying and during air drying, and of the Q_s value and weight of untreated pressed pulp during air drying. The Q_s value of the unpressed pulp was very low (1·09 mean value) and increased on pressing to a mean of 1·42, decreasing to 1·34 for the sprayed pulp. It slowly increased to an average of 1·61 in the drying drum. The absence of an air-stream during further drying at 105°C in the laboratory drying oven caused a sharp bend in the curve where Q_s rose more sharply to 1·75, thus weakening the original theory that the Q_s falls again, when the pulp is over-dried, through hardening of the cells. The weight of the unpressed pulp was 167 g/250 cc on an average ; that of the pressed pulp was 145 g/250 cc, while the sprayed pulp weight increased to 170 g with a simultaneous increase in dry solids from 18 to 28%. During drying the weight fell continuously, so that the mean weight of the final "Sepa" pulp was 90 g/250 cc. No direct relationship between final moisture content and the swelling capacity was established, since the dry solids varied from 86 to 90% and the Q_s value fluctuated between 1·5 and 2·0. From grouping of results around 92% dry solids and around 1·7-1·8 Q_s value, these are considered to be optimal for the "Sepa" pulp, although the factors affecting pulp quality are not known. No optimal values have been found for other types of pulp. Tests on air drying at 40°C showed the same effect of weight drop with an increase on oven-drying as before. The Q_s was low, from which it is assumed that the R.H. during drying is a determining factor in the value of Q_s, which stays roughly the same during drving, rising only very slightly during oven-drying. The Q_s of the sprayed pulp increased from the start of the air-drying from 1·3 to 1·7. The tests are to be repeated during the 1958/59 campaign using a fully-automatic drum drier with automatic temperature and draught control.

* * *

Relationships Between Acid Content and Colour Formation on Dry Heating of Sucrose. H. HIRSCHMÜLLER and H. EICHHORN. *Zeitsch. Zuckerind.*, 1958, **83**, 112-114.—Pure sucrose, obtained by triple crystallization of refined sugar from a methyl alcohol-solution, to which was added in turn NH_4Cl, $(NH_4)_2SO_4$, NH_4NO_3, betaine chlorohydrate, $Fe_2(SO_4)_3$, $CaCl_2$, KCl and NaCl, was used in the study of the relationship between acidity and coloration of heated sucrose. The mixtures were heated to 170°C for 15 min in an oil bath and the melts dissolved in water and filtered. In each test the pH was determined with a quinhydrone or glass electrode, and the extinction coefficient at 436 mμ measured after neutralization at pH 7·0. Two identical samples were used, the first unheated, being made up to 100 ml with distilled water and the pH related to the extinction coefficient of the heated sample in the form of a graph. All salts caused coloration and lowered the pH, the highest colour and lowest pH being caused by NH_4Cl. Extension of heating from 6 to 18 min also increased colour and lowered the pH of the melts. Mixtures of NH_4Cl and betaine hydrochloride each with Na_2CO_3, NaCl and $CaCl_2$ were also added to the sucrose. The Na_2CO_3 reduced the acid effect of the NH_4Cl and the colour formation, while NaCl and $CaCl_2$ increased coloration and lowered the pH. With betaine-HCl the Na_2CO_3 had the same effect as with NH_4Cl, whereas $CaCl_2$ and NaCl caused intensive coloration with low pH, there being a definite distinction between the values with $CaCl_2$ and with NaCl. The buffering capacity and conductivity of the sucrose was found to have no relationship with the colour formation.

* * *

Control Filtration of Carbonatation Juices. K. D. ZHURA. *Sakhar. Prom.*, 1958, (3), 23-26.—A laboratory apparatus for testing carbonatation juice filtrability is described and illustrated. The juice sample is heated to 80°C and poured into the test vessel, which comprises a glass cylinder mounted inside another; water in the annular space is used to heat the cylinder to the same temperature as the sample. The juice is filtered through filter paper mounted on a grid, a pressure of 0·3–0·5 atm. being used during settling of the precipitate and 1·5 during the actual measured filtration. The time taken to filter the sample is accurately checked by filtering 3–4 times. For comparison purposes the amount of juice is previously calculated to give a cake 1 cm thick. The filtration coefficient (K_f), which is given by V/F, where V = amount of filtrate in cu.m./min and F = area of cake in the vessel in sq.m., should be at least 5 to give satisfactory filtration.

[1] *I.S.J.*, 1957, **59**, 192.

PATENTS

UNITED STATES

Producing Clinical Dextran. L. J. NOVAK and G. S. STOYCOS, assrs. COMMONWEALTH ENGINEERING CO. OF OHIO, of Dayton, Ohio, U.S.A. **2,841,578.** 28th August, 1953; 1st July, 1958.—Dextran hydrolysed by the dextranase from *Aspergillus wentii* contains dextranic acid, and is purified by adding, at pH 1–5, about 50% by volume of a precipitant, e.g. iso-propanol, to the aqueous solution, collecting and redissolving in water, followed by reprecipitation with 50% by volume of iso-propanol, repeating this process as necessary.

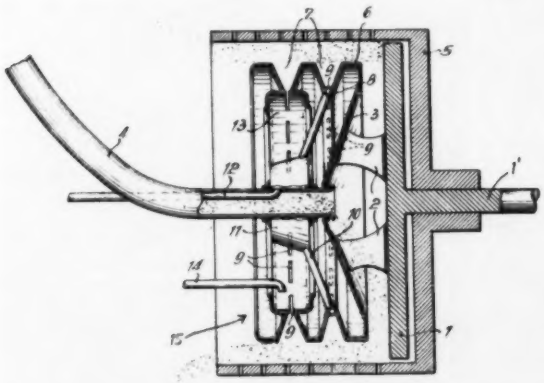
* * *

Beet Top Cleaner. J. P. GOMES, of Greenfield, Calif., U.S.A., **2,843,994.** 6th July 1956; 22nd July 1958.

* * *

Continuous Centrifugals. W. BUDDEBERG, of Starnberg, Germany, assr. KRAUSS-MAFFEI A. G., of Munich-Allach, Germany. **2,845,178.** 23rd February 1955; 29th July 1958.

In the centrifugal shown, the cylindrical basket 5 is rotated by a suitable means, not shown. A pusher 1 is carried by a shaft 1′ and rotates with the basket 5. It can be moved reciprocally along the direction of the basket axis by sliding the shaft 1′ along the bore of the shaft of basket 5. Mounted on the pusher 1 are a number of lugs 2 which carry



the slurry distributing mechanism 15. This has a conical end wall 3 which slides, with the motion of the pusher, along the end of feed pipe 4. The sugar is distributed to the cylindrical wall of the basket 5 which is perforated to allow liquids to separate. The reciprocation of the pusher causes the sugar to pass along and out of the basket. The sugar may be washed by wash liquids supplied from the annular grooves 7 in the side wall 6 of distributor 15. In the first of these, an annular pipe 8 carries slots, cut-outs or nozzles 9 which provide a spray and are supplied via conduit 10 from chamber 11 surrounding pipe 4. Chamber 11 is supplied by pipe 12 which is sealed by welding into pipe 4.

The second wash-groove 7 is provided with slots 9 leading from trough 13 which is fed by pipe 14. The chamber 11 and trough 13 are formed between side plates parallel with the pusher which are so spaced that the distance between them is greater than the stroke of the pusher, and the exit of the pipes 12 and 14 always remains between these side-walls.

* * *

Beet Topper. H. C. OPPEL, of Boise, Idaho. **2,852,902.** 21st June, 1954; 23rd September, 1958.

* * *

Feed Supplement for Ruminants. L. F. WIGGINS, assr. SUGAR RESEARCH FOUNDATION INC., of New York, N.Y., U.S.A., and SOUTHWESTERN SUGAR AND MOLASSES CO. of New York, N.Y., U.S.A. **2,853,385.** 12th April 1956; 23rd September 1958.—An aqueous ammoniated sugar-containing material is extracted with a substantially water-immiscible organic solvent, followed by treating with a non-toxic acid to give a pH of 3–6.

* * *

Continuous Beet Diffuser. K. HEINRICH, of Grevenbroich, Germany. **2,853,405.** 5th January 1953; 23rd September 1958. *See* U.K.P. 782,651 and 782,652[1].

* * *

Rapid Kraft Pulping Process for Bagasse and other Fibrous Non-woody Ligno-Cellulosic Plant Materials. S. B. KNAPP and J. D. WETHERN, assrs. HAWAIIAN DEVELOPMENT CO. LTD., of Honolulu, Hawaii, U.S.A. **2,854,334.** 8th November 1954; 30th September 1958.—A mixture is made of 1 part of plant material (bagasse or de-pithed bagasse) with 2–15 parts (5–7 parts or 3–5 parts) of a digesting liquor containing sodium hydroxide and sodium sulphide with a sulphidity of 15–35% (20–30%), the combined weight of NaOH and Na_2S being 6–20% (8–16%) of that of the plant material. The mixture is heated during up to 15 minutes (1 sec–5 min) to a temperature of 140–210°C (160–190°C) and then maintained at 140–210°C (160–190°C) for 30 sec –5 min (1–3 min). The pressure may be reduced to blowing pressure over 1 sec–10 min (1 sec–3 min).

* * *

UNITED KINGDOM

Hydrogenation of Sugars. USINES DE MELLE, of Melle, Deux-Sevres, France. **801,732.** 27th July 1956; 17th September 1958.—Glucose, levulose or invert sugar is reduced to sorbitol, mannitol or a mixture of these, respectively, by batchwise or continuous hydrogenation in an aqueous solution containing

[1] *I.S.J.*, 1958, **60**, 83.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 2s each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

70–95% (80%) of an aliphatic alcohol containing three or less carbon atoms per molecule (methanol or ethanol) in the presence of a nickel catalyst (Raney nickel or nickel deposited on kieselguhr). The pressure used is 15–25 kg/sq.cm. and the temperature 50–170°C (80–150°C). The polyalcohol is recovered by crystallization from the solution on cooling.

* * *

Recovery of Glutamic Acid from Fermentation Residues. INTERNATIONAL MINERALS & CHEMICAL CORP., of Chicago, Ill., U.S.A. **802,560**. 28th January, 1957 ; 8th October, 1958.—A vinasse is hydrolysed by heating at 60°C—100°C in the presence of an alkaline earth oxide or hydroxide ($Ca(OH)_2$) and 1–1·2 equivalents of an alkali metal salt (Na_2CO_3), giving a salt of the alkaline earth less soluble than its hydroxide, such that the pH is at least 12·5 (13). The hydrolysate is filtered, and adjusted to pH 5–7 with acid (HCl), treated with at least 10 lb (at least 25 lb) tannin per ton of vinasse solids, the precipitate filtered and the liquor concentrated to 50–85% solids, filtered and adjusted to pH 3·2 to crystallize the glutamic acid. The $CaCO_3$ precipitate may be washed and the washings returned to process.

* * *

Beet Harvesters. A. M. JONGENEEL, of Rio Vista, California, U.S.A. **802,973.** 19th July 1957 ; 15th October 1958.

* * *

Rectifying Ethanol by Distillation under Elevated Pressure. A. B. CHEMATUR, of Stockholm, Sweden. **803,047**. 18th February 1957 ; 15th October 1958.—Crude fermentate is distilled to give a condensate containing 5–50% by weight of alcohol. This is freed from impurities, preferably after dilution with water, in a stripping column, the pH at the bottom of the stripping column being maintained below 7, and rectifying the alcoholic bottoms from the stripping column in a rectifying column at a pressure greater than 2 kg/sq. cm. (greater than 4·5 kg/sq. cm.), with the addition of an alkali to maintain the pH at the bottom of the rectifying column above 6·5. Aqueous liquor from the bottom of the rectifying column is fed to the stripping column for the alcohol condensate. Vapours from the rectifying column are fed to a steam generator.

* * *

Beet Pulp Press. A.B. LANDSVERK, of Landskrona, Sweden. **803,215**. 6th November 1956 ; 22nd October 1958.—The press comprises a vertical spindle 1 inside a cylindrical screen jacket within an outer cylindrical casing 4. The space between the cylinders is divided into three compartments, each with separate drains 5, 6, 7, by intermediate partitions 2. Mounted on the spindle 1 are pairs of screw flights S_1, S_2, S_3, S_4, interrupted by stationary guide plates 8. The spindle is mounted in upper and lower bearings 9, 17, and has an upper extension 10 carrying stirrer arms 11, which operate in a hopper chamber 12. This is of sufficient capacity to permit passage of pulp through it in 7 minutes at normal maximum operation of the press. The hopper is fed by the feed worm 16 in its channel 15. The spindle is driven by motor 21 through the transmission gears 19, 20. Pressed pulp passes through the end ring 22 and supporting disc 23 by way of a rotatable valve disc 24. This is provided with openings which are the same size as corresponding openings in the supporting disc. Thus as the valve disc 24 is rotated (by means of a hand-wheel) the overlap of these openings, i.e. the free passage for pressed pulp, is reduced. The dimensions of the cylinder 3, spindle 1 and scrolls are so arranged that the value of the volume of the first press chamber P_1 multiplied by the number of flights in this chamber

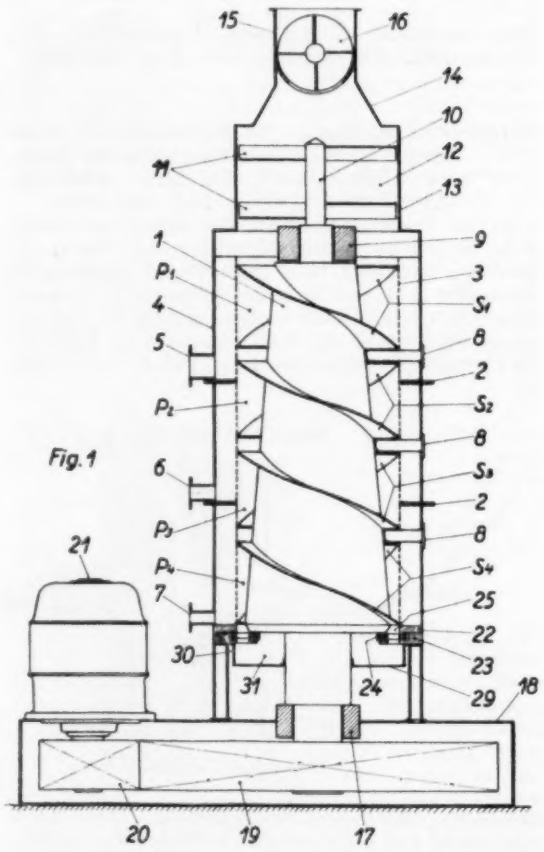
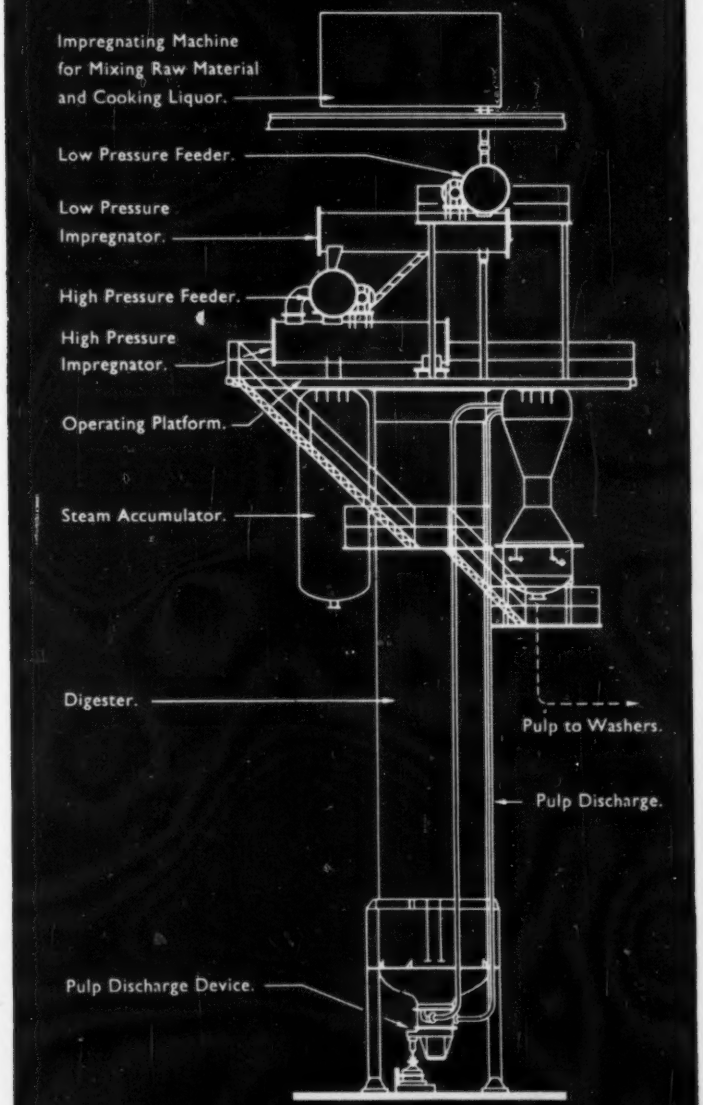


Fig. 1

and the screen area is at least 4 times as great as the corresponding value for the last press chamber P_4, and at least 3 times as great as the value for the 3rd press chamber P_3 and at least twice as great as for the 2nd press chamber P_2. For a press with 8 press chambers, the values above would be substantially in the proportions of 8 : 4 : 2·7 : 1·8 : 1·6 : 1·4 : 1·2 : 1. The pressure in the last press chamber is controlled by adjustment of valve disc 24, and is at least 3·5 atmospheres absolute.

CELDECOR-KAMYR

The Kamyr continuous pressure digestion system for sulphate, soda or mono-sulphite processes, specially adapted for bagasse, esparto, straw and similar agricultural residues



Salient features

High pressure but extremely safe

Accurately controlled digestion time

Low steam and power consumption

Entire plant in one unit

Choice of chemical processes

Easily connected to a recovery system

Positive pressure seal at inlet and outlet

Requires only 1 operator per shift

Full details available from:

CELDECOR

Cellulose Development Corporation Ltd

Hatch End, Middlesex

Tel: Hatch End 2261 Cables: Celdecor, Pinner

70–95% (80%) of an aliphatic alcohol containing three or less carbon atoms per molecule (methanol or ethanol) in the presence of a nickel catalyst (Raney nickel or nickel deposited on kieselguhr). The pressure used is 15–25 kg/sq.cm. and the temperature 50–170°C (80–150°C). The polyalcohol is recovered by crystallization from the solution on cooling.

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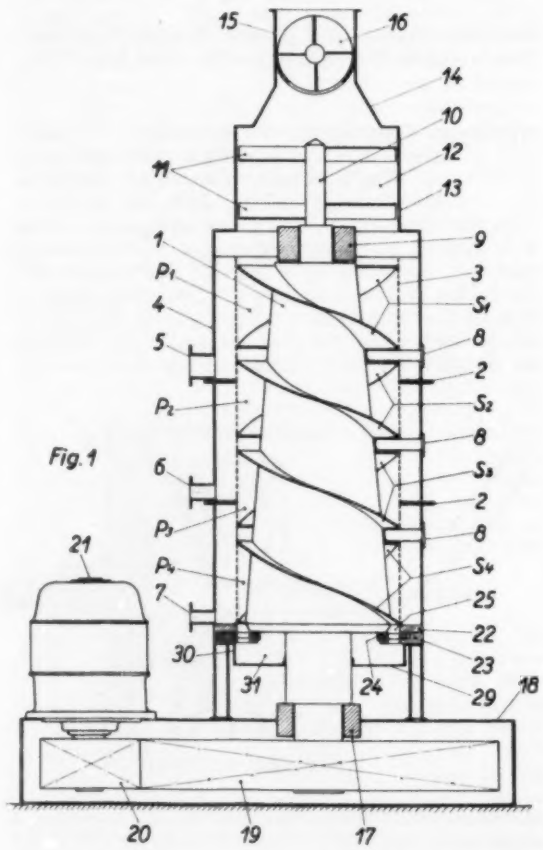

Fig. 1

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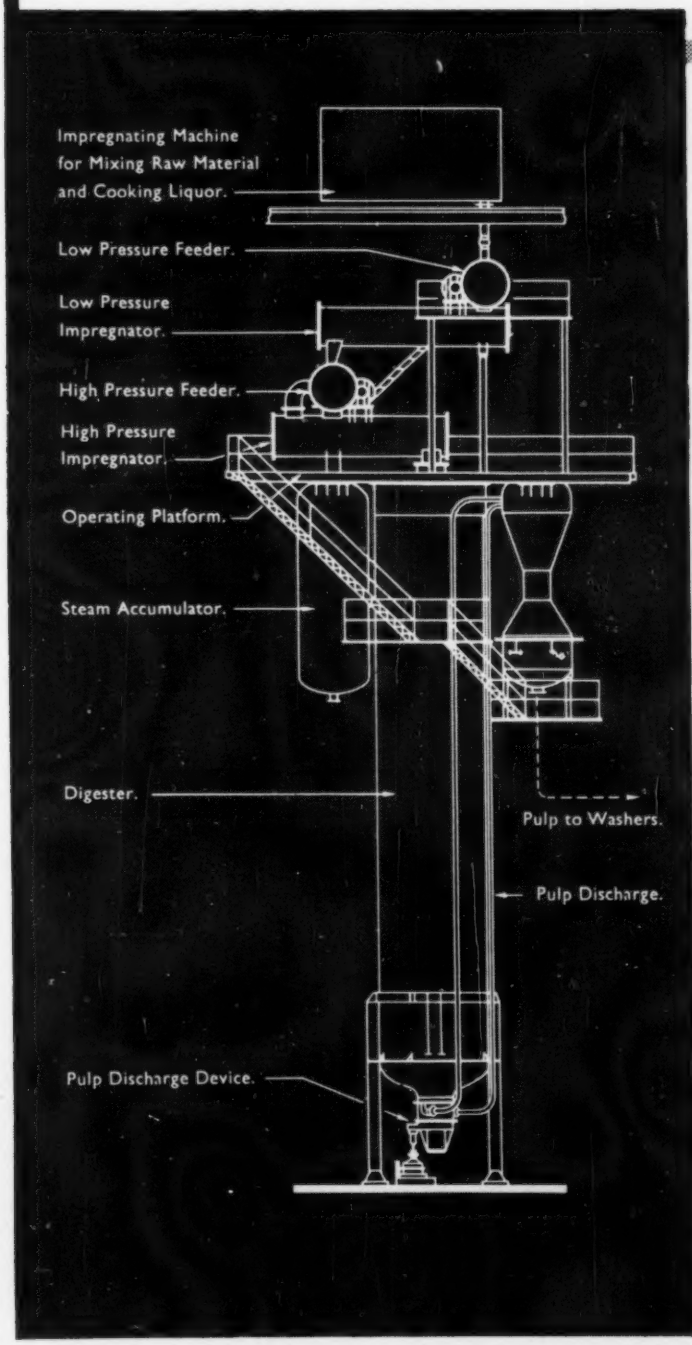

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Requires only 1 operator per shift

Full details available from:

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Tel: Hatch End 2261 Cables: Celdecor, Pinner

A Suma Product

The Cuitometer

"AN INDISPENSABLE ACCESSORY"

("La Sucrerie de Cannes")

"The **CUITOMETER** is particularly useful for low-grade pans, especially for C-massecuites, but it performs a useful function everywhere, and can be said to be an indispensable accessory of the pan-boiler today. With its aid, apprentice boilers can boil with as much sureness as a master-boiler and maintain the cook at the optimum supersaturation point without risk of false grain."

"Each pan should have its CUITOMETER. The relatively insignificant cost of this instrument permits of this."

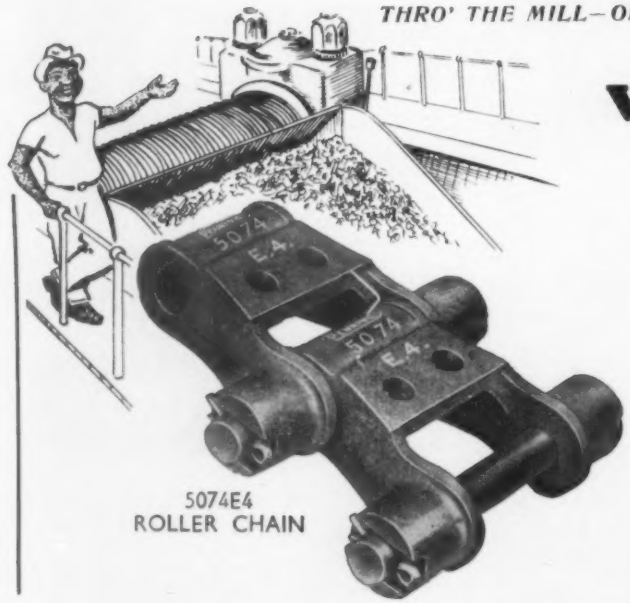
Extracted by kind permission from "La Sucrerie de Cannes" (pp. 475–476), by E. Hugot. (Dunod Editeur, 92, Rue Bonaparte, Paris 6e). 1950. Price : 5,300 francs.

The Sugar Manufacturers' Supply Co. Ltd.

7 & 8, IDOL LANE, LONDON, E.C.3, ENGLAND.

Cables : "Sumasuco, London."

THRO' THE MILL—ON PENNINE CHAIN



5074E4
ROLLER CHAIN

well-fed rollers

Intermediate carriers feeding cane fibre between mill rollers have to withstand severe wear during grinding seasons, and Pennine 5074E4 Chains, for double-sprocket use, are highly recommended for this service.

Heavy outside driving lugs give longer wear. The twin attachment holes are equidistant from pins for slat assembly with laps leading or trailing.

Other rollers and pintle chains suitable for intermediate carrier work can also be supplied.

Sugar production runs smoother on Pennine chain

TOUGH MALLEABLE IRON—LONG WEARING
INTERCHANGEABLE WITH OTHER MAKES

Catalogues on request: **PENNINE CHAINBELT CO. LTD., ARMLEY, LEEDS 12, ENGLAND**

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

New Machine For Grinding and Fluting Rolls. Thomas Robinson & Son Ltd., Rochdale, Lancs.

Designed to operate at the best possible speed consistent with absolute accuracy, this machine is intended to meet the need for "on-the-spot" work both in this country and overseas. It will take rolls up to 60 in long and 24 in diameter, and auxiliary equipment, which includes a special driving unit, can be supplied for the grinding only of rolls up to 32 in diameter.

The swivelling tool-head is mounted on a base bolted to the bed of the machine, ensuring stability and holding the tools rigidly when clamped in the correct position relative to the roll. Adjustment of the head to and from to the roll is by a handwheel, which can be locked in any position.

The grinding wheel is mounted on a hardened and ground steel spindle, running in self-lubricating adjustable gun metal bearings, the spindle being driven by vee-belts from a 7½ h.p. motor mounted on slide rails.

The fluting tools are carried in two precision-built tool boxes, mounted at the rear of the grinding wheel and fitted with fine feed screws and graduated collars. A lifting lever fitted to the boxes, worked by stops fixed to the table, lifts the tool off the roll on the backward stroke of the table.

The roll is turned for grinding by a 1½ h.p. motor rigidly mounted on a swing plate attached to the headstock. Transmission is by means of a variable speed vee-belt drive to worm reduction gearing which drives the twisting head sleeve and chuck through a dog clutch. The action of engaging this clutch disengages the dog clutch used for fluting.

Lubrication of the bed slides is carried out whilst the table is in motion, by oil wells cast into the bed and kept at constant level by oil fillers with level indicators. The bed slides are kept free from dirt by felt pads at the table ends.

An electric pump and tank are supplied with the machine, giving an ample supply of grinding lubricant to enable the grinding wheel to cut freely. A settling tank is also supplied.

A stop-start push-button station controlling all motors is conveniently mounted on the base of the headstock. The free-standing starter panel can be placed in any convenient position.

* * *

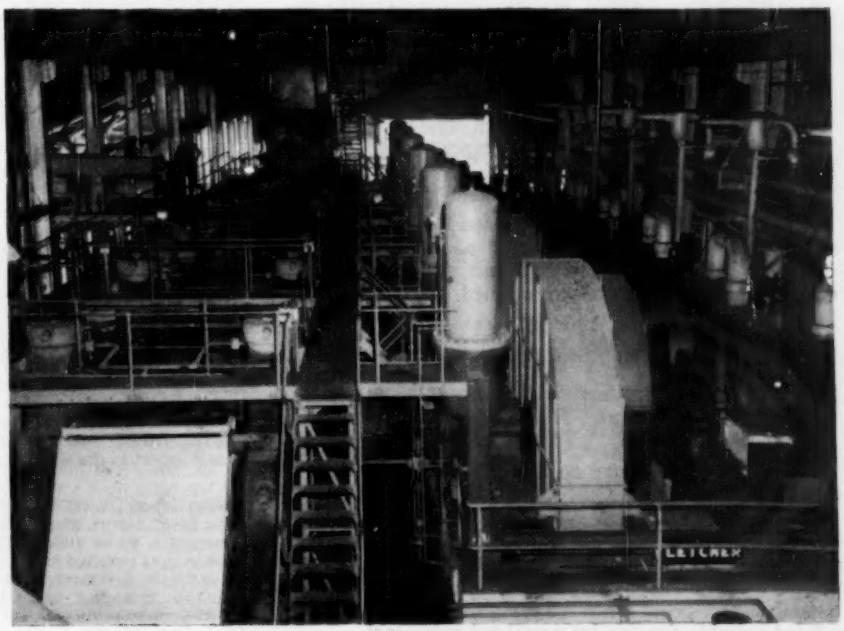
Fletcher Tandem for Swaziland. George Fletcher & Co. Ltd., Masson Works, Whitchurch Lane, Derby.

George Fletcher & Company of Derby have received an order valued at nearly £300,000 from Sir J. L. Hulett & Sons Limited for a cane mill tandem for their new factory at Mhlume in Swaziland.[1]

The mill tandem consists of six three-roller cane crushing mills 34 in × 66 in, complete with intercarriers, driven by six single stage steam turbines, each developing 632 b.h.p. at full load. Each turbine drives through two sets of totally enclosed double reduction double helical gear boxes giving a peripheral speed of the rollers of up to 70 ft per minute. The mills are fitted with hydro-pneumatic accumulators and the order also includes hydraulic force pumps, maceration pumps, inspection platforms and a mechanical juice strainer and cush cush elevator with motor drive.

The illustration shows a plant similar to that ordered for Swaziland, which was supplied recently to Boca Chica factory, Dominican Republic.

[1] *I.S.J.*, 1958, **60**, 154.



B.B.A. Helitube Heat Exchangers. British Boiler Accessories Ltd., 62–63 Fenchurch Street, London E.C.3.

The "Helitube" heat exchangers are available in the standard range covering 2·6 to 616 sq. ft. heating surface and can be mounted vertically or horizontally. Copper, aluminium or copper alloy tubes are tightly coiled into a helical shape and secured to tube plates by means of a tight fitting ferrule (steel and stainless steel tubes are welded to the plates). The tubes of not more than ½ inch dia. are formed into a kidney-shape section and are surrounded by an external jacket. The design causes the flow of liquid in the jacket to run over most of the tube surface, ensuring good heat transference.

* * *

The Rowe Pinch Valve. W. H. Rowe & Son Ltd., Quayside Road, Southampton.

The Rowe pinch-valve, which is available in sizes from 1 in to 3 in bore diameter, is of die-cast construction, both the casing and internal parts. Specially designed reinforced sleeves are used, suitable for internal pressures up to 100 p.s.i.

The aluminium alloy casing is split on its vertical axis for ease of assembly and servicing, and completely encloses the flexible sleeve and operating mechanism.

The closing mechanism consists of two die-cast aluminium alloy anvils, a screwed spindle, and a handwheel which operate to compress the sleeve equally from both sides.

The reinforced sleeves are available in four grades of natural or synthetic rubber materials, including one for general purpose duties, and another specially compounded to withstand repeated steam scalding where food products are being handled. Another grade is suitable for abrasive materials.

* * *

Portable pH Meter. Analytical Measurements Ltd., Dome Buildings, The Quadrant, Richmond, Surrey.

A pH meter which can be carried in a camera-type ever-ready case is completely self-contained with batteries giving up to 1300 hours use. The meter scale reads from 2–12 pH in 0–2 divisions, and an accuracy of 0·1 pH is obtainable. The case includes plastic tubes of buffered KCl solutions and the unit is both water-proof and fungus proof. It is considered suitable for use by untrained personnel.

PUBLICATIONS RECEIVED

NEW MARTIN-MARKHAM PRODUCTS. Martin's Cultivator Co. Ltd., Stamford, Lincs.

A new leaflet describes the "Sabre-Disc" mounted disc harrow which is suitable for use with most tractors and is designed to produce a deep and even seed bed across the whole of its working width. The "Discmaster" medium weight harrows for wheeled tractors are also available as are the new spring-time harrow cultivators. These use the Continental pattern "Vibra-Tine" and give a very fine tilth with a depth of penetration greater than obtainable previously with this type of implement. The tines can be spaced for row-crop work.

* * *

ADEQUATE WEIGHING AND FEED CONTROL. Adequate Weighers Ltd., Bridge Works, Bridge Road, Sutton, Surrey.

A new catalogue gives information on the "Adequate" weigher which is used in a wide variety of industries for measurement of the weight of material passing along a conveyor belt at speeds up to 730 f.p.m., and records the weight passed on either one or two dials. The rate of feed may be indicated either optically or remotely by electronic means. The "Feedometer" equipment controls the rates of flow of constituents which have to be mixed in definite proportions and can be mechanically or electrically controlled.

* * *

MULTI-LOUVRE DRYERS. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

A new 16-page book on multi-louvre dryers contains information on drying, cooling and processing of bulk materials in a variety of industries.

* * *

APV ALCOHOL AND YEAST PLANT. The A.P.V. Co. Ltd., Manor Royal, Crawley, Sussex.

A new leaflet, A 318, describes the facilities offered by the Chemical Engineering Division of The A.P.V. Co. Ltd., including laboratory investigations, provision of process data, engineering design, supply of all plant and buildings, and erection and commissioning services. Illustrations show equipment supplied for fermentation, distillation and yeast production with descriptions, while the factory at Crawley is described briefly and illustrated. A list is given of some recently supplied A.P.V. alcohol plants.

* * *

CAMBRIDGE GAS ANALYSERS. Cambridge Instrument Co. Ltd., 13 Grosvenor Place, London S.W.1.

A new leaflet, List 144/C, illustrates the indicators, recorders and controllers for a wide range of gas mixtures including CO_2 in air and SO_2 in air.

* * *

The Hungarian "J"-Type Continuous Beet Diffuser.—The first of the "J"-diffusers[1] was installed at Petohaza last campaign, and has a capacity of 700 tons of beet per day. Draught is about 120% and sugar loss is reduced to 0·2% which is approximately half that with the previous battery. The cossettes are scalded at 90°C just after entering the shorter section of the "J" and a temperature of 70°C is maintained in the rest of the diffuser. As the cossettes and juice are not exposed to the air, microbiological activity is negligible and the exhausted slices are thus of good colour, while juice quality is higher than that obtained with the battery. The Lang Machine Factory has five more installations under construction, including units for home use and export to the U.S.S.R.

* * *

Indian Export Quotas under the International Sugar Agreement.—The basic export quota allotted to India under the 1958 Agreement is to be 100,000 metric tons, raw value, and not 25,000 tons as reported in our last issue[1]. Similarly, the special reserve for the first three years of the Agreement will be 50,000 metric tons, raw value, and not 75,000 tons as quoted.

[1] *I.S.J.*, 1958, **60**, 178.

WORLD SUGAR PRODUCTION ESTIMATES[1]

(Metric tons, raw value)

BEET SUGAR

	1958/59	1957/58
EUROPE.		
Western Germany	1,835,000 (a)	1,585,796 (a)
Austria	284,000	284,231
France	1,600,000	1,572,512
Belgium	415,000	388,423
Holland	570,000	396,854
Denmark	390,000	366,667
Sweden	263,000	324,000
Italy	1,111,000	867,000
Spain	491,000	332,601
Yugoslavia	196,200	260,840
Switzerland	34,000	37,603
Great Britain	740,000	625,616
Eire	120,000	125,555
Finland	37,500 (b)	32,061 (b)
Turkey	380,000	356,111
Eastern Germany	875,000	852,222
Czechoslovakia	850,000	879,790
Hungary	286,000	275,656
Poland	1,178,000	1,178,442
Roumania	225,000	205,942
Bulgaria	132,000	149,539
Russia	6,200,000	4,900,000
Total Europe	18,212,700	15,997,461

(a) Including sugar made from foreign beets.

(b) Including 8555 tons and 4834 tons respectively made from foreign beets.

	1958/59	1957/58
United States	2,000,000	1,986,755
Canada	145,000	127,439
Uruguay	26,000	26,495
Chile	55,000	34,700
Algeria	3,000	2,098
Azores	6,000	6,000
Japan	119,000	95,252
China (Manchuria)	340,000	275,000
Iran	112,000	110,000
Afghanistan	5,500	5,326
Israel	18,000	13,000
Syria	9,000	9,000
Total non-Europe	2,838,500	2,691,065

CANE SUGAR

EUROPE.		
Spain	26,500	29,259
NORTH AND CENTRAL AMERICA.		
Cuba	6,000,000	5,776,307
United States	565,000	484,442
Puerto Rico	1,000,000	837,284
Hawaii	950,000	770,950
British West Indies :		
Trinidad	192,000	186,980
Barbados	195,000	155,293
Jamaica	395,000	354,676
Antigua	40,000	22,352
St. Kitts	50,000	42,844
Other British West Indies	15,000	12,679
Virgin Islands	12,500	9,042
Dominican Rep.	910,000	906,286
Mexico	1,380,000	1,241,804
Martinique	83,000	74,400
Guadeloupe	139,000	130,000
Haiti	38,000	39,372
Guatemala	65,000	63,504
Salvador	48,000	48,988

Cane Sugar—*Continued*

	1958/59	1957/58
British Honduras	14,000	11,243
Honduras	15,000	14,000
Nicaragua	64,000	60,516
Costa Rica	45,000	38,102
Panama	27,000	25,584
Total	12,242,500	11,306,648
SOUTH AMERICA.		
Argentina	900,000	728,930
Brazil	2,940,000	2,662,618
Peru	726,000	711,215
British Guiana	305,000	297,793
Uruguay	5,400	3,576
Surinam	7,500	7,500
Venezuela	210,000	171,506
Bolivia	25,000	24,000
Ecuador	80,000	79,833
Colombia	230,000	221,355
Paraguay	39,000	32,070
Total	5,467,900	4,940,396
AFRICA.		
Egypt	308,000	306,074
Ethiopia	36,700	36,123
Mauritius	530,000	562,003
Réunion	206,000	211,100
Union of South Africa	1,004,000	870,790
Mozambique	170,000	163,295
Angola	65,000	61,813
British East Africa	148,000	134,804
Madagascar	66,700	44,400
French Equatorial Africa	7,000	6,000
Belgian Congo	32,000	21,999
Rhodesia	6,500	7,165
Madeira	6,000	6,000
Total	2,585,900	2,431,566
ASIA		
India :		
White sugar	2,315,000	2,415,000
Khandsari	160,000	110,000
Indonesia	650,000	780,000
Pakistan	215,000	175,288
Burma	50,000	45,002
Philippines	1,169,000	1,190,964
Taiwan	919,000	913,064
China	900,000	625,000
Thailand	70,000	68,130
Vietnam	12,000	5,000
Total	6,460,000	6,327,448
OCEANIA.		
Australia	1,382,000	1,273,048
Fiji Islands	196,000	199,136
Total	1,578,000	1,472,184
Cane Sugar	28,360,800	26,507,501
Beet sugar	21,051,200	18,688,526
Grand Total	49,412,000	45,196,027

[1] F. O. LICHT *International Sugar Report*, 1958, **90**, (11), 1–2.

Stock Exchange Quotations

London Stocks (*at 16th December* 1958)	CLOSING MIDDLE
Anglo-Ceylon (5s)	17/9
Antigua Sugar Factory (£1)	17/6
Booker Bros. (10s)	23/–
British Sugar Corp. (Ltd. (£1)	18/–
Caroni Ord. (2s)	4/4½
Caroni 6% Cum. Pref. (£1)	17/6
Distillers Co. Ltd. (6s. 8d units)*	32/–
Gledhow Chaka's Kraal (£1)	66/3
Hulett & Sons (£1)	85/–
Jamaica Sugar Estates Ltd. (5s units)	7/6
Leach's Argentine (10s units)	7/–
Reynolds Bros. (£1)	53/6
St. Kitts (London) Ltd. (£1)	52/6
Ste. Madeleine (Ord.) (£1)	29/–
Sena Sugar Estates (10s)	24/–
Tate & Lyle (£1)†	73/3
Tate & Lyle Investments Ltd. (5s)	16/3
Trinidad Sugar (5s stock units)	11/6
United Molasses (10s stock units)	35/–
West Indies Sugar Co. Ltd. (£1)	27/6

* Shares to be written up to 10s. 0d. followed by a 1 for 4 scrip issue.

† Shares are "cum" a 3 for 5 scrip issue.

New York Stocks (*at 15th December* 1958)	CLOSING MIDDLE $
American Crystal ($10)	44
Amer. Sugar Ref. Co. ($100)	34¼
Central Aguirre ($5)	22¼
Cuban American ($10)	28⅛
Great Western Sugar	30¾
South P.R. Sugar	31⅛
United Fruit Co.	39¾
West Indies Sugar Corp. ($1)	51½

U.S. 1958 Domestic Quota Changes[1].—On November 13th, the U.S.D.A. announced that an increase had been made in the Cuban 1958 quota by 50,000 tons prorated from deficits of other areas. A corresponding decrease was made in the increase prorated to the U.S. Domestic Beet areas, since they have advised the Department that the beet sugar industry will not be able to market its full increased quota and retain a sufficient reserve to ensure adequate supplies to its customers prior to the 1959/60 campaign. In addition, Peru has become entitled to an additional quota of 31,279 short tons since she has acceded to the current International Agreement[2].

* * *

Bureau of Sugar Experiment Stations, New Headquarters.[3]—The Bureau of Sugar Experiment Stations, which is responsible for agricultural research in the Queensland sugar industry, has moved to new headquarters in Gregory Terrace, Brisbane which were opened on 4th December. The new air-conditioned brick building will house one of the most modern research centres in the State. As well as up-to-the-minute laboratory equipment provision has been made for an insect-proof quarantine house where hundreds of imported cane varieties will be isolated for testing before the most suitable are distributed to growers throughout the State. The tremendous advance made by the Queensland sugar industry in recent years has been largely due to the work of the Bureau, which is constantly breeding new varieties of cane, not only of a more disease-resistant character but with a greater sugar content.

I.S.S.C.T.

10th Congress, 1959

The opening programme for 4th May has been announced by Dr. Roger P. Humbert, Chairman of the Programme and Publications Committee. A. G. Budge, President of the Hawaiian Sugar Planters' Assn., will welcome the delegates, following opening of the Congress by General Chairman, Dr. L. D. Baver.

The Governor of the Territory of Hawaii will welcome visitors of the 10th Congress to the Islands.

W. W. G. Moir, Secretary-Treasurer of I.S.S.C.T. will outline the history and background of the Hawaiian sugar industry. This will be followed by a luncheon and open house at the Experiment Station, H.S.P.A., in the afternoon.

On the following day, tours start for both field and factory delegates and their wives. No formal meetings will be held until these trips conclude on 17th May.

The week of 18th—23rd May will be devoted to formal meetings in Honolulu. Dr. L. D. Baver will outline "Highlights of The Experiment Station, H.S.P.A., Research" on the opening programme.

Dr. Henry B. Hass, Director of Sugar Research Foundation of New York City, will discuss "The Current Status of Sucrochemistry". Dr. Byron T. Shaw, Research Administrator, U.S. Department of Agriculture, will speak on "Basic Research and Its Contribution to American Agriculture". "The Origin and Functioning of the U.S. Sugar Act" will be discussed by Slator M. Miller, vice-president of the Hawaiian Sugar Planters' Assn., and head of their office in Washington, D.C.

During the remainder of the week symposia will be held on subjects which were selected by the 17 regional vice chairmen and section chairmen of the society as those of greatest interest to sugar men around the world. "Yield Decline", "Milling" and "Payment for Cane" are subjects of top interest.

Purity Tables.—The Centre Technique de la Canne à Sucre at Abymes, Guadeloupe, French West Indies, have announced that they have prepared a series of tables of polarization and purities based on the equations :

$$\text{Pol} = \text{saccharimeter reading} \times \frac{26{\cdot}00}{100 \times d}$$

and

$$\text{Purity} = \text{saccharimeter reading} \times \frac{26{\cdot}00}{100 \times d \times \text{Brix}}.$$

where d is the density of the juice at 27½° C compared with water at 4°. They are prepared for Brix values at intervals of 0·1° Brix and will cost $4.00 or the equivalent in sterling or Dutch currency.

[1] *Lamborn*, 1958, **36**, 246.
[2] C. Czarnikow Ltd., *Sugar Review*, 1958, (380), 195.
[3] *Queensland Newsletter*, 11th December, 1958.

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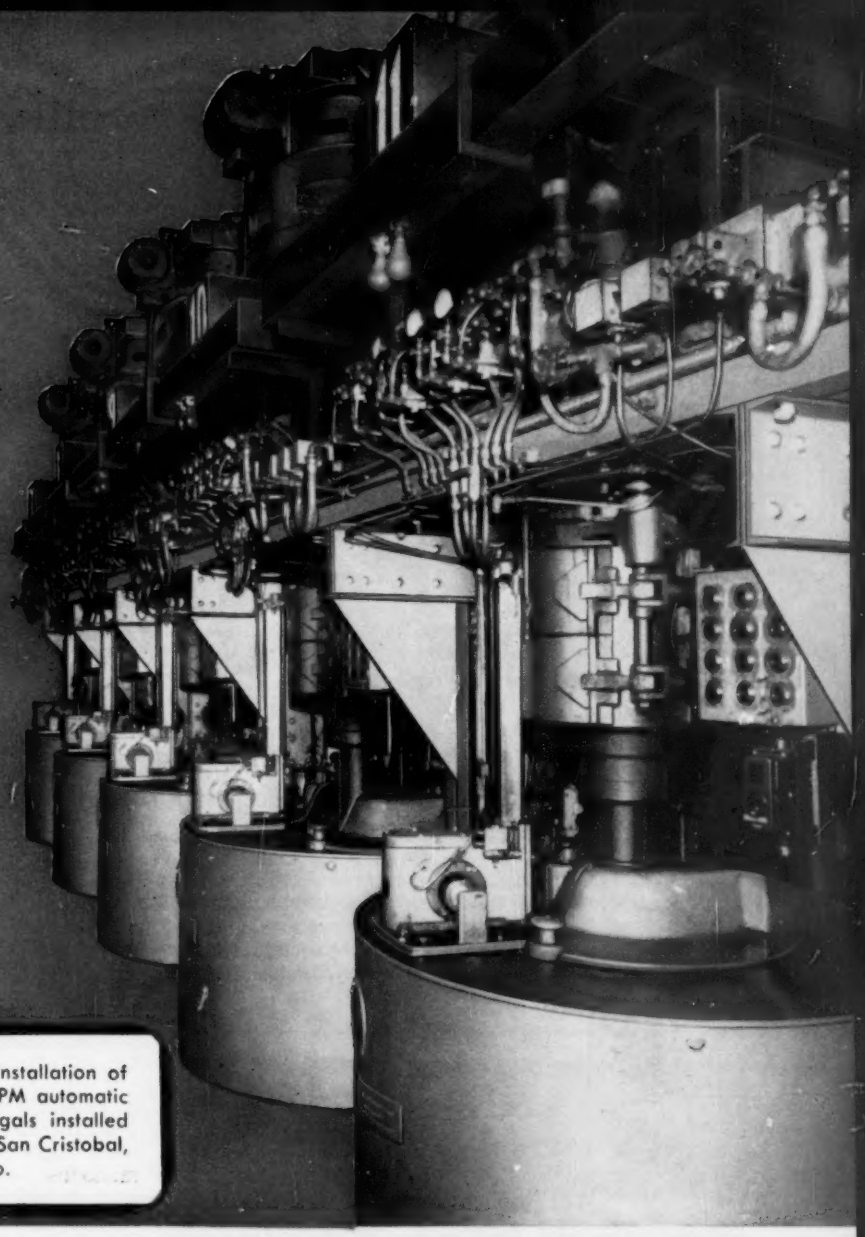

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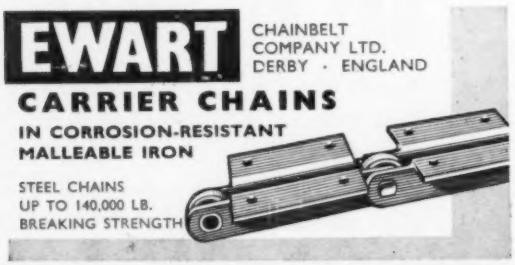

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S. H. Johnson & Co. Ltd.

Filter-Leaves.
Cane Sugar Divn., Dorr-Oliver Inc. (*Sweetland*).
Enzinger Division, The Duriron Co. Inc. (Angola).
Ferguson Perforating & Wire Co.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.

Filter Papers.
W. & R. Balston Ltd.
T. B. Ford Limited.
G. H. Heath & Son (1952) Ltd.
S. H. Johnson & Co. Ltd.
Macherey, Nagel & Co., Inh. Dr. Ing. Adolf Radmacher.
Carl Schleicher & Schüll.
Sparkler Manufacturing Company.
The Sugar Manufacturers' Supply Co. Ltd.

Flowmeters.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Honeywell Controls Ltd.
Kelvin & Hughes (Industrial) Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.
Wright Rain Ltd. (*Irrigation*).
Wright Rain Africa (Pvt.) Ltd. (*Irrigation*).

Friction Materials (Industrial).
Johns-Manville International Corp.

Fullers' Earth.
The Fullers' Earth Union Ltd.

Gearing, *see* Reduction Gears.

Gearmotors.
David Brown Industries Ltd., Coventry Gear Divn.
Crofts (Engineers) Ltd.
Hinz Elektromaschinen und Apparatebau.

Grabs, Cane and Beet.
Walkers Ltd.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

Heat Exchangers, Air-cooled.
Wellington Tube Works Ltd.

Heat Exchangers, Plate Type.
A.P.V. Co. Ltd., Chemical Engineering Division.
George Cohen, Sons, & Co. Ltd.

Heat Exchangers, Tubular.
Blairs Ltd.
George Clark & Sons (Hull Ltd.
George Fletcher & Co. Ltd.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.
Walkers Ltd.
Wellington Tube Works Ltd.

Hydraulic Controls for Valves, etc.
Edwards Engineering Corp.
Duncan Stewart & Co. Ltd.
Walkers Ltd.

Instruments, Process Control.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Hilger & Watts Ltd.
Honeywell Controls Ltd.
Kelvin & Hughes (Industrial) Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.

Insulation, Thermal (Heat and Cold).
The Cape Asbestos Co. Ltd.
Fibreglass Ltd.
Johns-Manville International Corp.
William Kenyon & Sons Ltd.
Lafarge Aluminous Cement Co. Ltd.

Ion Exchangers.
Cane Sugar Divn., Dorr-Oliver Inc.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
John Thompson-Kennicott Ltd.

Irrigation Equipment.
Farrow & Sons Ltd.
Markham Traction Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Jointings, *see* Packings and Gaskets.

Juice Heaters.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Walter Thron G.m.b.H.
Walkers Ltd.

Juice Scales.
Butz & Leitz G.m.b.H.
George Fletcher & Co. Ltd.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
see also Weighing Machines.

Juice Strainers and Screens.
Ashworth & Parker Ltd.
Blairs Ltd.
William Boulton Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Cocksedge & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Link-Belt Company.
John McNeil & Co. Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Russell Constructions Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Walkers Ltd.

Juice and Syrup Mixers.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.

Juice and Syrup Mixers—*continued*
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
Gutehoffnungshütte Sterkrade A.G.
L. A. Mitchell Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd

Knives, Beet.
H. Putsch & Comp.

Knives, Milling.
Blairs Ltd
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Walkers Ltd.

Knives, Milling, Portable Grinders.
Flexotube (Liverpool) Ltd.

Laboratory Apparatus and Equipment.
International Combustion (Export) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
The Tintometer Ltd.

Electric Heating appliances.
Isopad Ltd.
see also Laboratory Instruments *and* Saccharimeters and Polarimeters, *etc.*

Laboratory Instruments.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Degenhardt & Co. Ltd.
Evershed & Vignoles Ltd.
A. Jobin & G. Yvon.
Rotameter Manufacturing Co. Ltd.
Sugar Manufacturers' Supply Co. Ltd.
John Thompson Instrument Co. Ltd.

Refractometers.
Hilger & Watts Ltd.
Schmidt & Haensch.

Laboratory Reagents.
Riedel-de Haën A.G.
The Sugar Manufacturers' Supply Co. Ltd.

Ladders, Steel Lattice.
Grill Floors Ltd.

Lime Density Meters.
Rotameter Manufacturing Co. Ltd.

Liming Equipment.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Walkers Ltd.

Locomotives, Diesel.
W. G. Bagnall Ltd.
Andrew Barclay, Sons & Co. Ltd.
George Cohen, Sons & Co. Ltd.
Robert Hudson Ltd.
Hudswell, Clarke & Co. Ltd.
Hunslet Engine Co. Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Orenstein & Koppel Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S.I. International, Divn. of U.S. Industries Inc.
Walkers Ltd.

Magnetic Separators.
Electromagnets Ltd.
Klöckner-Humboldt-Deutz A.G.
Rapid Magnetic Machines Ltd.

Massecuite Heat Treating Equipment.
Blairs Ltd.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
A. & W. Smith & Co. Ltd.
Walkers Ltd.
The Western States Machine Co. (*Stevens System*).

Mechanical Crop Thinning Machines.
S.K.H. & Son (Salopian–Kenneth Hudson & Son).

Metal Detectors.
Metal Detection Ltd.

Mill Hydraulics.
Edwards Engineering Corp.
The Mirrlees Watson Co. Ltd.
Duncan Stewart & Co. Ltd.
Walkers Ltd.

Mill Rolls.
Bethlehem Steel Export Corp.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
G. M. Hay & Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Walkers Ltd.

Mill Roll Movement Indicators and Recorders.
Edwards Engineering Corp.
Walkers Ltd.

Milling Plant.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
David Brown Industries, Ltd., General Gear Division.
David Brown Industries Ltd., Jackson Division.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
G. M. Hay & Co. Ltd.
International Combustion (Export) Ltd.
Kek Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.

Milling Plant—*continued*
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.
Walkers Ltd.
see also Shredders.

Molasses Tanks.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Mechans Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Walkers Ltd.

Packeting Machinery.
Brecknell, Dolman & Rogers Ltd.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.
Richard Simon & Sons Ltd.
Swiss Industrial Company.

Packings and Gaskets.
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.

Pans, Vacuum.
Bennett, Sons & Shears Ltd.
Blairs Ltd.
William Boulton Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Technoexport Czechoslovakia.
Walkers Ltd.

Paper and Board from Bagasse.
Cellulose Development Corp. Ltd.
Lyddon & Co. Ltd.

Pipes, Steam.
Bethlehem Steel Export Corp.
Kirk & Co. (Tubes) Ltd.
Duncan Stewart & Co. Ltd.
Talbot Stead Tube Co. Ltd.
Wellington Tube Works Ltd.

Pipe Fittings.
see Tube Fittings.

Ploughs—Disc.
David Brown Industries Ltd., Tractor Division.
Krupp-Dolberg G.m.b.H.
Martin's Cultivator Co. Ltd.
Ransomes Sims & Jefferies Ltd.
S.K.H. & Son (Salopian–Kenneth Hudson & Son).

Ploughs—Share.
David Brown Industries Ltd., Tractor Division.
Krupp-Dolberg G.m.b.H.
Ransomes Sims & Jefferies Ltd.

Power Transmission Equipment.
Crofts (Engineers) Ltd.
William Kenyon & Sons Ltd.

Pressure Gauges.
The British Rototherm Co. Ltd.
Honeywell Controls Ltd.

Printing Machinery—Rotary Multi-Colour for Sugar Cartons and Bags, etc.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.

Pulverizers, Sugar.
George Cohen, Sons & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Kek Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Walkers Ltd.

Pumps.
Braunschweigische Maschinenbau-anstalt.
Cellulose Development Corp. Ltd.
George Cohen, Sons & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
The Duriron Company Inc.
Farrow & Sons Ltd.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Harland Engineering Co. Ltd.
International Combustion Export) Ltd.
The Mirrlees Watson Co. Ltd.
Saunders Valve Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Worthington-Simpson Ltd.

Boiler Feed pumps.
Lee, Howl & Co. Ltd.

Centrifugal pumps.
Lee, Howl & Co. Ltd.

Corrosion-proof pumps.
L. A. Mitchell Ltd.
Mono Pumps Ltd.

Gear pumps.
David Brown Industries Ltd., General Gear Divn.

Irrigation Pumps.
Lee, Howl & Co. Ltd.
Markham Traction Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Molasses Pumps.
Mono Pumps Ltd.
Lee, Howl & Co. Ltd.

Positive-action Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.

Reciprocating Pumps.
Lee Howl & Co. Ltd.

Rotary Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Machinefabriek Reineveld N.V.

Steam Pumps.
Lee, Howl & Co. Ltd.

Vacuum Pumps.
see Vacuum Pumps.

Railway, *see* Locomotives *and* Track.

Reduction Gears.
Bethlehem Steel Export Corp.
David Brown Industries Ltd., General Gear Division.
David Brown Industries Ltd., Radicon Divn.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Crofts (Engineers) Ltd.
William Gardner & Sons (Gloucester) Ltd.
William Kenyon & Sons Ltd.
The Power Plant Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Walkers Ltd.

Refinery Equipment.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Honolulu Iron Works Co.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stordy Engineering Ltd.
Suchar Engineering & Sales Co.
Technoexport Czechoslovakia.

Refractory Bricks.
General Refractories Ltd.
Johns-Manville International Corp.
The Leeds Fireclay Co. Ltd.
John G. Stein & Co. Ltd.

Refractory Cement.
General Refractories Ltd.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd.
The Leeds Fireclay Co. Ltd.
John G. Stein & Co. Ltd.

Rotary Hoes.
Rotary Hoes Ltd.

Saccharimeters and Polarimeters.
Bellingham & Stanley Ltd.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.
Schmidt & Haensch.
The Sugar Manufacturers' Supply Co. Ltd.

Sack Closing Machines.
Thomas C. Keay Ltd.
The Sack Filling & Sewing Machine Syndicate Ltd.

Sack Filling Machines.
Brecknell, Dolman & Rogers Ltd.
Librawerk.
Richard Simon & Sons Ltd.

Sack Printing Machines.
Thomas C. Keay Ltd.

Scaffold boards.
Grill Floors Ltd.

Scale Removal and Prevention.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
The Geigy Company Ltd.
The Kleen-e-ze Brush Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Screens, Centrifugal, *see* Centrifugal Screens.

Screens, Vibrating.
William Boulton Ltd.
Büttner-Werke A.G.
Cocksedge & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
John McNeil & Co. Ltd.
Russell Constructions Ltd.
Spencer (Melksham) Ltd.
Duncan Stewart & Co. Ltd.
Walkers Ltd.
see also Juice Strainers and Screens.

Ship Loading installations.
Buhler Brothers.

Shredders.
Braunschweigische Maschinenbau-anstalt.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.
Walkers Ltd.

Skip Hoists.
Hugh Campbell (London) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Spencer (Melksham) Ltd.
Strachan & Henshaw Ltd.

Spectrophotometers.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.

Steam Storage Equipment.
Cochran & Co., Annan, Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Steam Superheaters.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.

Steam Traps.
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
Walkers Ltd.

Steam Turbines for Mill Drives, etc.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Escher Wyss Ltd.
Soc Fives Lill-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.

Steel.
Bethlehem Steel Export Corp.
George Cohen, Sons & Co. Ltd.

Steel Bar and Wire.
Talbot Stead Tube Co. Ltd.

Steel Flooring and Handrailing.
Grill Floors Ltd.

Stokers—Bagasse Burning Spreader Type.
Babcock & Wilcox Ltd.

Sugar Factory Design and Erection (Cane and Beet).
Honolulu Iron Works Co.
Salzgitter Industriebau G.m.b.H.

Sugar Machinery, General.
Blairs Ltd.
Braunschweigische Maschinenbau-anstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.
U.C.M.A.S.
Walkers Ltd.

Sugar Throwers and Trimmers.
Spencer (Melksham) Ltd.

Temperature Recorders and Controllers.
The British Rototherm Co. Ltd.
Evershed & Vignoles Ltd.
Honeywell Controls Ltd.
Kelvin Hughes (Industrial) Ltd.
Taylor Controls Ltd.

Thermometers.
The British Rototherm Co. Ltd.
Taylor Controls Ltd.

Torque Converters.
Walkers Ltd.

Track and Track Accessories.
Bethlehem Steel Export Corp.
Robert Hudson Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Railway Mine & Plantation Equipment Ltd
Spoorijzer N.V. Delft.
U.S.I. International, Divn. of U.S. Industries Inc.

Tractors.
David Brown Industries, Tractor Divn.
Marshall Sons & Co. Ltd.

Trailers.
Robert Hudson Ltd.
Whitlock Brothers Ltd.

Trench Gratings.
Grill Floors Ltd.

Tubes, Bi-Metal.
Talbot Stead Tube Co. Ltd
Yorkshire Imperial Metals Ltd.

Tubes for Boilers, Evaporators, Juice Heaters, Vacuum Pans, etc.
Bethlehem Steel Export Corp.
Hudson & Wright Ltd.
Kirk & Co. (Tubes) Ltd.

Tubes for Boilers, etc.—*continued*
Talbot Stead Tube Co. Ltd.
Yorkshire Imperial Metals Ltd.

Tubes, Carbon, Alloy and Stainless Steel
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.

Tube Cleaners, *see* Scale Removal and Prevention.

Tube Fittings.
Blakey's Boot Protectors (*malleable iron*).
Kirk & Co. (Tubes) Ltd. (*malleable iron and stainless steel*)
Talbot Stead Tube Co. Ltd. (*stainless steel*).
Yorkshire Imperial Metals Ltd. (*copper and brass*)

Vacuum Pans, *see* Pans.

Vacuum Pumps.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Comet Pump & Engineering Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
International Combustion (Export) Ltd.
The Mirrlees Watson Co. Ltd.
Ateliers Neyret Beylier.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Walkers Ltd.
Worthington-Simpson Ltd.

Valves.
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
David Brown Industries Ltd., Foundries Divn.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd
The Duriron Company, Inc.
Saunders Valve Co. Ltd.
Talbot Stead Tube Co. Ltd.
Taylor Controls Ltd.
Walkers Ltd.

Variable Speed Controls.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd
Duncan Stewart & Co. Ltd.

Vehicle washes.
Grill Floors Ltd.

Water Cooling Towers.
Foster Wheeler Ltd.

Weighing Machines.
Butz & Leitz G.m.b.H.
Fr. Hesser Maschinenfabrik A.G. Librawerk.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
see also Juice Scales.

Wrapping machines.
SAPAL.

BUYERS' GUIDE—ADDRESS LIST

The A.P.V. Co. Ltd., Chemical Engineering Division,
Manor Royal, Crawley, Sussex.
Tel. : Crawley 1369. *Cable* : Anadastic, Crawley.

von Arnim'sche Werke G.m.b.H.,
Werk Schneider & Helmecke,
Offenbach/Main, Germany.
Tel. : Offenbach 82054.
Cable : Kondenstopf, Offenbach/Main.

Ashworth & Parker Ltd.,
Riverside Works, Bury, Lancs., England.
Tel. : Bury 5125–6. *Cable* : Kinetic, Bury.

Babcock & Wilcox Ltd.,
Babcock House, 209 Euston Rd., London, N.W.1, England.
Tel.: Euston 4321. *Cable:* Babcock, London.
Telex: 2–3256.

W. G. Bagnall Ltd.,
Castle Engine Works, Stafford, England.
Tel. : Stafford 321. *Cable* : Bagnall, Stafford.

W. & R. Balston Ltd.,
see H. Reeve Angel & Co. Ltd.

Andrew Barclay Sons & Co., Ltd.
Caledonia Works, Kilmarnock, Scotland.
Tel.: Kilmarnock 1366/7. *Cable:* Barclayson, Kilmarnock.

Bellingham & Stanley Ltd.,
71 Hornsey Rise, London, N.19, England.
Tel. : Archway 2270. *Cable* : Polyfract, London.

Belliss & Morcom Ltd.,
Ledsam Street Works, Birmingham 16, England.
Tel. : Edgbaston 3531. *Cable* : Belliss, Birmingham 16.

Bennett, Sons & Shears Ltd.,
9–13 George Street, Manchester Square, London, W.1, Eng.
Tel. : Welbeck 8201. *Cable* : Cuprite, London.

F. W. Berk & Co. Ltd.,
Berk House, Portman Square, London, W.1.
Tel. : Hunter 6688. *Cable* : Berk, London.
Telex: 23796.

Bethlehem Steel Export Corp.,
25 Broadway, New York 4, N.Y., U.S.A.
Cable : Bethlehem, New York.

Blairs Ltd.,
Glasgow Engineering Works, Woodville Street, Govan, Glasgow, S.W.1, Scotland.
Tel. : Govan 1261 *Cable* : Blazon, Glasgow.

Blakey's Boot Protectors Ltd.,
see Pennine Chainbelt Co. Ltd.

William Boulton Ltd.,
Providence Engineering Works, Burslem, Staffs., England.
Tel.: Stoke-on-Trent 88661. *Cable:* Boultons, Burslem.

Braunschweigische Maschinenbauanstalt,
(20b) Braunschweig, Bahnhofstrasse 5, Germany.
Tel. : Braunschweig 23691. *Cable* : Bema, Braunschweig.
Telex : Bema Bswg. 0952840

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol 5, England.
Tel.: Bristol 58222. *Cable:* Bremaners, Bristol.

British Ropes Ltd.,
Leith, Edinburgh 6, Scotland.
Tel.: Leith 36811. *Cable:* Roperie, Leith.
Telex: 72338.

The British Rototherm Co. Ltd.,
Merton Abbey, London S.W.19, England.
Tel.: Liberty 7661. *Cable:* Rototherm, London.

Thomas Broadbent & Sons Ltd.,
Central Ironworks, Huddersfield, England.
Tel : Huddersfield 5520. *Cable* : Broadbent, Huddersfield.

J. Brockhouse & Co. Ltd.,
Victoria Works, Hill Top, West Bromwich, Staffs., England.
Tel. : Wednesbury 0243.
Cable : Brockhouse, West Bromwich.

Brotherton & Co. Ltd.,
P.O. Box 6, Brotherton House, Westgate, Leeds 1, England.
Tel.: Leeds 2–9321. *Cable:* Brotherton, Leeds.
Telex: 55–116.

David Brown Corporation (Sales) Ltd.,
96/97 Piccadilly, London, W.1, England.
Tel. : Grosvenor 5271. *Cable* : Davibron, London.

David Brown Industries Ltd., Coventry Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Foundries Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., General Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Jackson Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Radicon Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Tractor Division,
see David Brown Corporation (Sales) Ltd.

Maschinenfabrik Buckau R. Wolf A.G.,
Grevenbroich/Ndrrh., Germany.
Tel. : Grevenbroich 1481.
Cable : Maschinenbau, Grevenbroich.
Telex : masch fab grev 08517 898.

Buell (1952) Ltd.,
3 St. James's Square, London, S.W.1, England.
Tel. : Trafalgar 2528. *Cable* : Allentare, London.

Buhler Brothers,
Uzwil, Switzerland.
Tel.: 65212 Uzwil *Cable* : Buhler, Uzwil.
Telex : 57902

Büttner-Werke A.G.,
Postfach 59, Krefeld-Uerdingen 1, Germany.
Tel.: Krefeld 43511. *Cable:* Büttner, Krefeld-Uerdingen.

Butz & Leitz G.m.b.H.,
(22b) Ludwigshafen a. Rh., Industriestrasse, Germany.
Tel.: Ludwigshafen 63618/9, 64003.
Cable : Butzleitz, Ludwigshafenrhein.

Hugh Campbell (London) Ltd.,
Kent House Lane, Beckenham, Kent, England.
Tel.: Sydenham 8178, 8238. *Cable:* Mechandle, Beckenham.

The Cape Asbestos Co. Ltd.,
114 & 116 Park Street, London, W.1., England.
Tel.: Grosvenor 6022. *Cable:* Incorrupt, London.

Catchpole Engineering Co. Ltd.,
19 Hatter Street, Bury St. Edmunds, Suffolk, England.
Tel.: Bury St. Edmunds 2591.
Cable: Beslift, Bury St. Edmunds.

C.E.C.A.,
24 Rue Murillo, Paris 8e, France.
Tel. · Car 8200. *Cable* : Ceca, Paris.

Cellulose Development Corporation Ltd.,
Hatch End, Middlesex, England.
Tel. : Hatch End 2261. *Cable* : Celdecor, Pinner.

Chambon Ltd.,
Riverside Works, Standish Road, London W.6., England.
Tel.: Riverside 6086. *Cable:* Chambonted, London.

Choquenet L. Fonderies et Ateliers—Sté. Ame,
Chauny (Aisne), France.
Tel. Chauny 34.

George Clark & Sons (Hull) Ltd.,
Hawthorn Avenue, Hull, England.
Tel.: Hull 37654. *Cable:* Clark, Hull.

The Clydesdale Chemical Co. Ltd.,
105 Millerston Street, Glasgow, E.1, Scotland.
Tel.: Bridgeton 4374. *Cable:* Cactus, Glasgow

Cochran & Co., Annan, Ltd.,
Annan, Dumfriesshire, Scotland.
Tel: Annan 111. *Cable:* Multitube, Annan.

Cocksedge & Co. Ltd.,
Grey Friars Road, Ipswich, Suffolk, England.
Tel.: Ipswich 56161. *Cable:* Cocksedge, Ipswich.

George Cohen, Sons & Co. Ltd.,
58 Wood Lane, London, W.12, England.
Tel.: Shepherds Bush 2070. *Cable:* Omniplant, London.
Telex: 2–2461.

Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, England.
Tel.: Thornton Heath 3816. *Cable:* Comet, Croydon.

Cotton Bros. (Longton) Ltd.,
Crown Works, Portland Road, Longton, Stoke-on-Trent, Staffs., England.
Tel.: Longton 33021. *Cable:* Cotbro, Stoke-on-Trent.

A. F. Craig & Co. Ltd..
Caledonia Engineering Works, Paisley, Scotland.
Tel.: Paisley 2191. *Cable:* Craig, Paisley.

Crofts (Engineers) Ltd.,
Thornbury, Bradford 3, Yorkshire, England.
Tel.: Bradford 65251. *Cable:* Crofters, Bradford.
Telex: 51186.

James A. Cuthbertson Ltd.,
Station Road, Biggar, Lanarkshire, Scotland.
Tel.: Biggar 20. *Cable:* Mechadrain, Biggar.

Davey, Paxman & Co. Ltd.,
Standard Iron Works, Colchester, Essex, England.
Tel.: Colchester 5151. *Cable:* Paxman, Colchester.
Telex: 1875.

Dallow, Lambert & Co. Ltd.,
Thurmaston, Leicester, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.

Degenhardt & Co. Ltd.,
6 Cavendish Square, London W.1., England.
Tel.: Langham 6097/9.

Deren & Co. S.A.,
Barentin (Seine-Maritime), France.
Tel.: Rouen 75–83–30. *Cable:* Deren, Barentin.
Telex: Rouen 78.064.

Dicalite Department, Great Lakes Carbon Corp.,
18 East 48th Street, New York 17, N.Y., U.S.A.
Tel.: Eldorado 5–6200. *Cable:* Dicalite, New York.

Cane Sugar Division, Dorr-Oliver Inc.,
Stamford, Conn., U.S.A.

Dunford & Elliott Process Engineering Ltd.,
Linford Street, London, S.W.8, England.
Tel.: Macaulay 2405. *Cable:* Lindaresco, London.

The Duriron Company Inc.,
450 N. Findlay Street, Dayton 1, Ohio, U.S.A.
Tel.: Clearwater 4–5344.

Edwards Engineering Corp.,
715 Camp Street, New Orleans 12, La., U.S.A.
Tel.: Tulane 0175. *Cable:* Joedco, New Orleans.

Eimco (Great Britain) Ltd.,
Earlsway, Team Valley, Gateshead 11, England.
Tel.: Low Fell 7–7241. *Cable:* Eimco, Gateshead.

Electroflo Meters Co. Ltd.,
Abbey Road, Park Royal, London, N.W.10, England.
Tel.: Elgar 7641. *Cable:* Elflometa, London.
Telex: 2–3196.

Electromagnets Ltd.,
Boxmag Works, Bond St., Hockley, Birmingham, England.
Tel.: Central 5391–3. *Cable:* Boxmag, Birmingham.

Enzinger Division, The Duriron Company Inc.,
P.O. Box 71, Angola, New York, U.S.A.
Tel.: Angola 188.

Escher Wyss Ltd.,
Terminal House, 52 Grosvenor Gardens, London, S.W.1, England.
Tel.: Sloane 8101. *Cable:* Escherwyss, London.

Evershed & Vignoles Ltd.,
Chiswick, London, W.4, England.
Tel.: Chiswick 3670. *Cable:* Megger, London.
Telex: 22–583.

Ewart Chainbelt Co. Ltd.,
Colombo Street, Derby, England.
Tel.: Derby 45451. *Cable:* Chainbelt, Derby.

Farnell Carbons Ltd.,
Conduit Road, Plumstead, London, S.E.18, England.
Tel: Woolwich 1158. *Cable:* Scofar, London.

Farrow & Sons Ltd.,
Spalding, Lincs., England.
Tel.: Spalding 3388. *Cable:* Farrows, Spalding.

Ferguson Perforating & Wire Co.,
130–140 Ernest Street, Providence, R.I., U.S.A.
Tel.: Williams 1–8876. *Cable:* Ferguson, Providence.

Fibreglass Ltd.,
St. Helens, Lancashire, England
Tel.: St. Helens 4224. *Cable:* Fibreglass, St. Helens.

Société de Fives Lille-Cail,
7 Rue Montalivet, Paris 8e, France.
Tel.: Anjou 22–01. *Cable:* Fiville, Paris.

George Fletcher & Co. Ltd.,
Masson Works, Litchurch Lane, Derby, England.
Tel.: Derby 45817. *Cable:* Amarilla, Derby.

Flexible Drives (*Gilmans*) **Ltd.,**
195 High Street, Smethwick, Staffs., England.
Tel.: Smethwick 1202 *Cable:* Skatoskalo, Birmingham.

Flexotube (Liverpool) Ltd.,
25, Hope Street, Liverpool 1, England.
Tel.: Royal 3345. *Cable:* Flexotube, Liverpool.

Fontaine & Co.,
Aachen, Germany.

T. B. Ford Ltd.,
30 New Bridge Street, London E.C.4., England.
Tel.: City 2272. *Cable:* Fordfilt, London.

Foster Wheeler Ltd.,
3 Ixworth Place, London, S.W.3, England.
Tel.: Kensington 6363. *Cable:* Rewop, London.

The Fullers' Earth Union Ltd.,
Patteson Court, Nutfield Road, Redhill, Surrey, England.
Tel.: Redhill 3521. *Cable:* Fullion, Redhill.

William Gardner & Sons (Gloucester) Ltd.,
Bristol Road, Gloucester, England.
Tel.: Gloucester 21261. *Cable:* Gardner, Gloucester.

The Geigy Company Ltd.,
Rhodes, Middleton, Manchester, England.
Tel.: Middleton 3644. *Cable:* Geigy, Middleton.

General Refractories Ltd.,
Genefax House, Tapton Park Road, Sheffield 10, Yorkshire, England.
Tel.: Sheffield 31113. *Cable:* Genefax, Sheffield.
Telex: 54–128.

Great Lakes Carbon Corp., *see* Dicalite Department.

E. Green & Son Ltd.,
Economiser Works, Wakefield, England.
Tel.: Wakefield 2706. *Cable:* Economiser, Wakefield.

Grill Floors Ltd.
West Row, North Kensington, London W.10., England.
Tel.: Ladbroke 3066/7 *Cable:* Etyladec, London.

Gruendler Crusher & Pulverizer Co.,
2915 North Market Street, St. Louis 6, Mo., U.S.A.
Tel.: Jefferson 1–1220. *Cable:* Grupulco, St. Louis.

Gutehoffnungshütte Sterkrade A.G.,
Werk Düsseldorf, Düsseldorf, Germany.

The Harland Engineering Co. Ltd.,
"B.E.P." Works, Alloa, Clackmannanshire, Scotland.
Tel.: Alloa 390. *Cable:* Electric, Alloa.
Telex: 77–337.

G. M. Hay & Co. Ltd.,
Strathclyde Foundry, 42 Fore Street, Whiteinch, Glasgow, W.4, Scotland.
Tel.: Scotstoun 4390. *Cable:* Castiron, Glasgow.

Heath Filtration Ltd.,
Sneyd Mills, Newcastle Street, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 84698/87172.

G. H. Heath & Son (1952) Ltd.,
Heathcote and Greenhead Works, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 87273/4/5. *Cable:* Durability, Burslem.

Heenan & Froude Ltd.,
Worcester, England.
Tel.: Worcester 3461. *Cable:* Heenan, Worcester.

Hein, Lehmann & Co. A.G.,
Abt. Massentrennung, P.O. Box 9107, Düsseldorf, Germany.
Tel.: 70201 *Cable:* Herrmannsieb, Düsseldorf.

Fr. Hesser Maschinenfabrik A.G.
Stuttgart-Bad Cannstatt, Nauheimerstr. 99, Germany.
Tel.: Stuttgart 53341. *Cable:* Hesser, Stuttgart-Bad Cannstatt. *Telex:* 072-2362

Hilger & Watts Ltd.,
98 St. Pancras Way, Camden Rd., London, N.W.1, England.
Tel.: Gulliver 5636. *Cable:* Sphericity, London.
Telex: 23852.

Samuel Hill Ltd.,
Lark Mill, Hare Street, Rochdale, Lancashire, England.
Tel.: Rochdale 2273. *Cable:* Filtering, Rochdale

Hinz Elektromaschinen und Apparatebau,
(20b) Braunschweig, Frankfurter Str. 1a, Germany.
Tel.: Braunschweig 25533/4. *Cable:* Hinzmotoren, Braunschweig.
Telex: 0952753.

Honeywell Controls Ltd.,
Ruislip Road East, Greenford, Middlesex, England.
Tel.: Waxlow 2333. *Cable:* Minnreg, Greenford.
Telex: 23465

Honolulu Iron Works Co.,
165 Broadway, New York 6, N.Y., U.S.A.
Cable: Honiron, New York

Robert Hudson Ltd.,
Raletrux House, Meadow Lane, Leeds, England.
Tel.: Leeds 20004. *Cable:* Raletrux, Leeds.

Hudson & Wright Ltd.,
Halberton Street, Birmingham 18, England.
Tel.: Smethwick 0675/6. *Cable:* Desac, Birmingham.

Hudswell, Clarke & Co. Ltd.,
120/122 Victoria Street, London, S.W.1, England.
Tel.: Victoria 6786. *Cable:* Hudclar, London.

Hunslet Engine Co. Ltd.,
125 Jack Lane, Leeds 10, Yorkshire, England.
Tel.: Leeds 32261. *Cable:* Engine, Leeds.

IMACTI, Industrieele Maatschappij Activit N.V.,
Postbus 240c, Amsterdam, Holland.
Tel.: 60153. *Cable:* Activit, Amsterdam.

International Combustion (Export) Ltd.,
19 Woburn Place, London, W.C.1, England.
Tel.: Terminus 2833. *Cable:* Lopulco, London

Isopad Ltd.,
Barnet By-Pass, Boreham Wood, Herts., England.
Tel.: Elstree 2817/9. *Cable:* Isopad, Boreham, Wood

A. Jobin & G. Yvon,
26 Rue Berthollet, Arcueil (Seine), France.
Tel.: Alésia 58–54.

Johns-Manville International Corp.,
22 East 40th Street, New York 16, N.Y., U.S.A.
Tel.: Lexington 2–7600. *Cable:* Johnsmanvil, New York.

S. H. Johnson & Co. Ltd.,
Carpenters Road, Stratford, London, E.15, England.
Tel.: Maryland 7431. *Cable:* Filtrum, London.

Thomas C. Keay Ltd.,
Baltic Street, Dundee, Scotland.
Tel.: Dundee 26031/4 *Cable:* Keay, Dundee.

Kek Ltd.,
Palmerston Street, Ancoats, Manchester 12, England.
Tel.: Ardwick 1104/5. *Cable:* Kekgrind, Manchester 12.

Kelvin & Hughes (Industrial) Ltd.,
Kelvin House, Wembley Park, Middlesex, England.
Tel.: Wembley 8888. *Cable:* Kelhue, Wembley.

William Kenyon & Sons Ltd.,
Dukinfield, Cheshire, England.
Tel.: Ashton-u-Lyne 1614. *Cable:* Kenyon, Dukinfield.

John King & Co. (Leeds) Ltd.,
Garnet Road, Leeds 11, Yorkshire, England.
Tel.: Leeds 75414. *Cable:* Malleable, Leeds.

Kirk & Co. (Tubes) Ltd.,
74/82 Paradise Street, London S.E.16, England.
Tel.: Bermondsey 3156/9. *Cable:* Kirflanges, London.

The Kleen-e-ze Brush Co. Ltd.,
Hanham, Bristol, England.
Tel.: Bristol 73027. *Cable:* Kleeneze, Bristol.

Klöckner-Humboldt-Deutz A.G.
Deutz Works, Köln-Deutz, Germany.
Tel.: Köln-Deutz 6721. *Cable:* Deutzmotor, Koln.
Telex: 0888511.

KnitMesh Ltd.,
36 Victoria Street, London, S.W.1, England.
Tel. Abbey 2684.

Krauss-Maffei-Imperial G.m.b.H. & Co.,
München-Obermenzing, Tannenweg 4, Germany.
Tel.: München 65 996. *Cable:* Imperial, München.
Telex: 052 3277.

Ets Krieg et Zivy,
9 Rue Louis-Lejeune, Montrouge (Seine), France.
Tel.: ALEsia 40–80. *Cable:* Krieg Zivy, Montrouge.

Krupp-Dolberg G.m.b.H.,
Essen, Germany.
Tel.: 21361 Essen. *Cable:* Dolberg, Essen.
Telex: 0857 732 dolberg

Lafarge Aluminous Cement Co. Ltd.,
73 Brook Street, London, W.1, England.
Tel.: Mayfair 8546. *Cable:* Cimenfondu, London.

Lancashire Dynamo & Crypto Ltd.,
St. Stephen's House, Victoria Embankment, London, S.W.1.
Tel.: Whitehall 7211–5. *Cable:* Umformer, London.
Telex: 23880.

Lancashire Dynamo Electronic Products Ltd.,
see **Lancashire Dynamo & Crypto Ltd.**

Lee, Howl & Co. Ltd.,
Tipton Engineering Works, Tipton, Staffs., England.
Tel.: Tipton 1878/9. *Cable:* Howl, Tipton.

The Leeds Fireclay Co. Ltd.,
Wortley, Leeds 12, Yorkshire, England.
Tel.: Leeds 638021. *Cable:* Fireclay, Wortley, Leeds.

Lepage, Urbain & Cie.,
105 Rue de la Convention, Paris 15e, France.
Tel.: Lecourbe 50–02. *Cable:* Alepage, Paris.

Librawerk,
Vossenkamp 1, Brunschweig, Germany.
Tel.: Sammel-Nr. 30851. *Cable:* Librawerk, Braunschweig.
Telex: 0952866.

Link-Belt Company, Department 1258 ISJL,
2680 Woolworth Building, New York 7, N.Y., U.S.A.
Tel.: Digby 9–4210. *Cable:* Linkbelt, New York.

N.V. Locospoor,
78 Bezuidenhout, The Hague, Holland.
Tel.: 720737. *Cable:* Locospoor, The Hague.

LURGI Gesellschaft für Chemotechnik m.b.H.,
Frankfurt/Main, Lurgihaus, Leerbachstrasse 72/74, Germany.
Tel.: 55–05–51. *Cable:* Lurgitechnik, Frankfurt.
Telex: 04–11108.

Lyddon & Co. Ltd.,
18/19 Savile Row, London, W.1, England.
Tel.: Regent 7321/9. *Cable:* Lyddexpor, London.
Telex: 2–2491

John McNeil & Co. Ltd.,
Colonial Iron Works, Helen St., Govan, Glasgow, S.W.1, Scotland.
Tel.: Govan 1246. *Cable:* Colonial, Glasgow.

Macherey, Nagel & Co., Inh. Dr. Ing. Adolf Radmacher,
Düren-Rhld., Postschliessfach 307, Germany.
Tel.: Düren 6169. *Cable:* Manapapier, Düren.

Marco Conveyor & Engineering Co. Ltd.,
Rowin Works, Lynn Road, Leytonstone, London, E.11, England.
Tel.: Leytonstone 2254/5. *Cable:* Engimarco, London.

Markham Traction Ltd.,
Lincolnshire Ironworks, Stamford, Lincoln, England.
Tel.: Stamford 2226. *Cable:* Marktrac, Stamford.

Marshall, Sons & Co. Ltd.,
Gainsborough, Lincs., England.
Tel.: Gainsborough 2301. *Cable:* Marshalls, Gainsborough.

Martin's Cultivator Co. Ltd., *see* Markham Traction Ltd.

Mechans Ltd.,
Scotstoun Iron Works, Glasgow W.4, Scotland.
Tel.: Scotstoun 2211. *Cable:* Nautical, Glasgow.
Telex: 77–234.

Metal Detection Ltd.,
Moseley Street, Birmingham 12, England.
Tel.: Victoria 0211. *Cable:* Metection, Birmingham.

The Mirrlees Watson Co. Ltd.,
45 Scotland Street, Glasgow, C.5, Scotland.
Tel.: South 2701. *Cable:* Mirrlees, Glasgow.

L. A. Mitchell Ltd.,
Harvester House, 37 Peter Street, Manchester 2, England.
Tel.: Blackfriars 7224. *Cable:* Inspection, Manchester.

Mono Pumps Ltd.,
Mono House, Sekforde Street, Clerkenwell Green, London, E.C.1, England.
Tel.: Clerkenwell 8911. *Cable:* Monopumps, London.

The New Conveyor Co. Ltd.,
Brook Street, Smethwick, Birmingham 40, England.
Tel.: Smethwick 2100. *Cable:* Aptitude, Birmingham.

Ateliers Neyret Beylier,
Boite Postale 48, Grenoble (Isère), France.
Tel.: Grenoble 44–73.80. *Cable:* Neyret, Grenoble.

N.V. Norit-Vereeniging Verkoop Centrale.
2de Weteringplantsoen 15, Amsterdam C, Holland.
Tel.: Amsterdam 39911 *Cable:* Noritcarbo, Amsterdam.

Etablissements A. Olier,
12 Avenue George-V, Paris, France.
Tel.: Elysées 27–30. *Cable:* Androlier, Paris

Orenstein & Koppel Ltd.,
31 Finsbury Square, London E.C.2., England.
Tel.: Monarch 4615. *Cable:* Orenkopp, London.

Parsons Chain Co. Ltd.,
Stourport-on-Severn, Worcestershire, England.
Tel.: Stourport 2551. *Cable:* Chainwork, Stourport-on-Severn.

The Paterson Engineering Co. Ltd.,
129 Kingsway, London, W.C.2, England.
Tel.: Holborn 8787. *Cable:* Cumulative, London.

Pennine Chainbelt Co. Ltd.,
Modder Place, Armley, Leeds 12, England.
Tel.: Leeds 63–8755. *Cable:* Pennine, Leeds

The Permutit Co. Ltd.,
Permutit House, Gunnersbury Avenue, London, W.4, England.
Tel.: Chiswick 6431. *Cable:* Permutit, London.

Pott, Cassels & Williamson Ltd.,
Motherwell, Scotland.
Tel.: Motherwell 22. *Cable:* Pott, Motherwell.

The Power-Gas Corporation Ltd.,
Parkfield Works, Stockton-on-Tees, Co. Durham, England.
Tel.: Stockton-on-Tees 67161.
Cable: Tetratomic, Stockton-on-Tees.
Telex: 58–530.

Power Plant Co. Ltd.,
West Drayton, Middlesex, England.
Tel.: West Drayton 2626. *Cable:* Roc, West Drayton.

H. Putsch & Comp.,
Postfach, Frankfurter Str. 5–25, Hagen/Westfalen, Germany.
Tel.: Hagen 22341. *Cable:* Putsch, Hagenwestf.
Telex: 0823/795.

Railway Mine & Plantation Equipment Ltd.,
Imperial House, Dominion Street, London, E.C.2., England.
Tel.: Monarch 7000. *Cable:* Minplan, London.
Telex: 23787

Ransome & Marles Bearing Co. Ltd.,
Newark-on-Trent, Notts., England.
Tel.: Newark 456. *Cable:* Bearings, Newark.
Telex: 37–306

Ransomes Sims & Jefferies Ltd.,
Orwell Works, Ipswich, England.
Tel.: Ipswich 54711. *Cable:* Ransomes, Ipswich.
Telex: 1874.

Rapid Magnetic Machines Ltd.,
Lombard Street, Birmingham 12, England.
Tel.: Victoria 1137. *Cable:* Magnetism, Birmingham.

Redler Conveyors Ltd.,
Dudbridge Works, Stroud, Glos., England.
Tel.: Stroud 1604/8. *Cable:* Redler, Stroud.

H. Reeve Angel & Co. Ltd.,
9 Bridewell Place, London, E.C.4, England.
Tel.: Fleet Street 9833. *Cable:* Papermen, London.
Telex: 23812, Stasaleco.

Machinefabriek Reineveld N.V.,
P.O. Box 22, Haagweg 127, Delft, Holland.
Tel.: Delft 24890. *Cable:* Reineveld, Delft.
Telex: 31027.

Richardson Scale Co. Ltd.,
Albert Street, Bulwell, Nottingham, England.
Tel.: Bulwell 27–8558. *Cable :* Autoweigh, Nottingham.

Riedel-de Haën A.G.
Seelze Hannover, Germany.
Tel.: Seelze 601. *Cable:* Riedelag Seelze.
Telex: 922748.

Rotameter Manufacturing Co. Ltd.,
330 Purley Way, Croydon, Surrey, England.
Tel. : Croydon 3816. *Cable :* Rotaflo, Croydon

Rotary Hoes Ltd.,
West Horndon, Essex, England.
Tel. : Herongate 361. *Cable :* Rotavator, Brentwood.

Russell Constructions Ltd.,
Russell House, Adam Street, Adelphi, London W.C.2, England.
Tel. : Temple Bar 0055 9. *Cable :* Russelcon, London.

Sackfilling & Sewing Machine Syndicate Ltd.,
Timewell Works, Lockfield Avenue, Brimsdown, Enfield, Middlesex, England.
Tel. : Howard 1188. *Cable :* Fecit, Enfield.

Salzgitter Industriebau G.m.b.H.,
Salzgitter-Drütte, Braunschweig, Germany.
Tel.: Salzgitter-Immendorf 5411.
Cable: Hüttenbau, Braunschweig.
Telex: 0952837/38.

Salzgitter Maschinen Aktiengesellschaft,
Salzgitter-Bad, Western Germany.
Tel. : Salzgitter 3441. *Cable :* Samag, Salzgitter-Bad.

SAPAL Société Anonyme des Plieuses Automatiques,
54 Avenue Dapples, Lausanne, Switzerland.
Tel.: Lausanne 26.10.95. *Cable :* Autoplieuse, Lausanne.

Saunders Valve Co. Ltd.,
Cwmbran, Newport, Monmouthshire, England.
Tel. : Cwmbran 3081. *Cable :* Saunval, Newport, Mon.

Carl Schleicher & Schüll,
Dassel, Kr. Einbeck, Germany.
Tel. : Dassel 395. *Cable :* Selecta, Dassel.

Schmidt & Haensch,
Naumannstrasse 33, Berlin-West, Germany.
Tel.: 71 16 25. *Cable:* Polarisation, Berlin.

Schumacher'sche Fabrik.
Bietigheim/W., Germany.
Tel.: 655–659. *Cable :* Bismolith, Bietigheim.
Telex : 724217.

Scottish Diatomite Co. Ltd.,
See William Kenyon & Sons Ltd.

Senior Economisers Ltd.,
11 Southampton Row, London, W.C.1, England.
Tel. : Holborn 7543–4. *Cable :* Senioreco, London

N.V. Servo-Balans,
Wegastraat 40, Den Haag, Holland.
Tel. : Den Haag 723874. *Cable :* Servobalans, Den Haag.

Richard Simon & Sons Ltd.,
Phoenix Works, Basford, Nottingham, England.
Tel. : Nottingham 75136. *Cable :* Balance, Nottingham.

S.K.H. & Son (Salopian–Kenneth Hudson & Son),
Prees, Whitchurch, Shropshire, England.
Tel. : Prees 331–5. *Cable:* Implements, Prees.

A. & W. Smith & Co. Ltd.,
21 Mincing Lane, London, E.C.3, England.
Tel. : Mansion House 4294. *Cable :* Sugrengine, London.
Telex : 2–2404

Sparkler International Ltd., European Branch,
Leliegracht 9, Amsterdam, Holland.
Tel.: Amsterdam 43077/44158. *Cable:* Spafileur, Amsterdam.

Sparkler Manufacturing Company,
169 North Lake Street, Mundelein, Ill., U.S.A.
Tel.: MU6–6430. *Cable:* Spafiltco, Mundelein.

S.P.E.I. Chim.,
Boite Postale 85–08, Paris (8e), France.
Tel. : Anjou 02–84 *Cable* Rectifpast, Paris.

Spencer (Melksham) Ltd.,
Melksham, Wilts., England.
Tel.: Melksham 2251/3. *Cable:* Spencer, Melksham.

Spoorijzer N.V. Delft.,
Postbox 10, Delft, Holland.
Tel. : 25931. *Cable :* Spoorijzer, Delft.
Telex : 31031

Standard Steel Corporation,
5073 Boyle Avenue, Los Angeles 58, California, U.S.A.
Tel. : LU 5–1234. *Cable :* Stansteel, Los Angeles.

John G. Stein & Co. Ltd.,
Bonnybridge, Stirlingshire, Scotland.
Tel : Banknock 255 8. *Cable :* Stein, Bonnybridge.
Telex : 77–506.

Stephens-Adamson Mfg. Co.,
Ridgeway Avenue, Aurora, Illinois, U.S.A.
Cable : Saco, Aurora, Ill.

Duncan Stewart & Co. Ltd.,
Park Gate, Glasgow, C.3, Scotland.
Tel: Douglas 1371–4. *Cable :* Stewart, Glasgow.

Stordy Engineering Ltd.,
Cumbria House, Goldthorn Hill, Wolverhampton, England.
Tel.: Wolverhampton 37341. *Cable:* Thermal, Wolverhampton.

Strachan & Henshaw Ltd.,
Steelhoist Works, St. Philips, Bristol 2, England.
Tel. : Bristol 78331. *Cable :* Stelhoist, Bristol.
Telex : 44–306.

Suchar Engineering & Sales Co.,
76 Beaver Street, New York 5, N.Y., U.S.A
Tel. : Whitehall 4–0280. *Cable :* Sucharing, New York.

Sugar Manufacturers' Supply Co. Ltd.,
7–8 Idol Lane, London, E.C.3, England.
Tel. : Mansion House 4710. *Cable :* Sumasuco, London.

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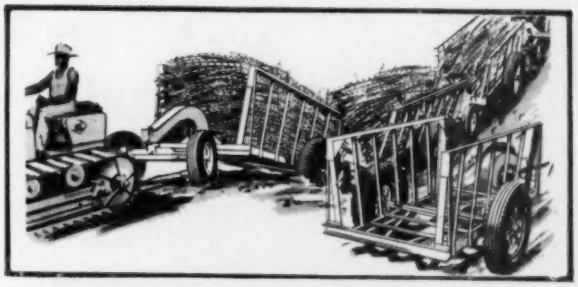

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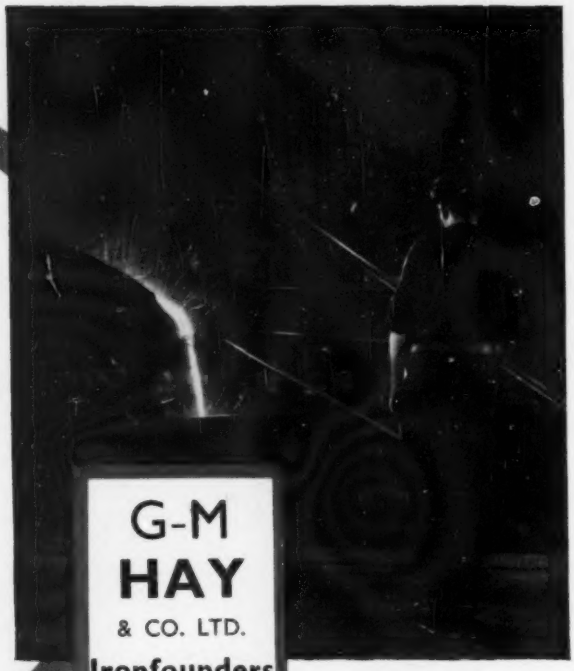

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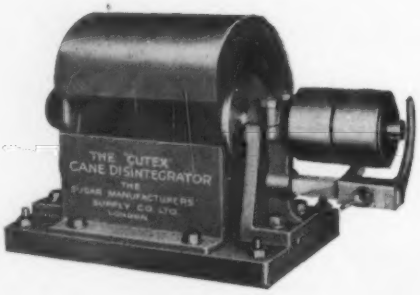

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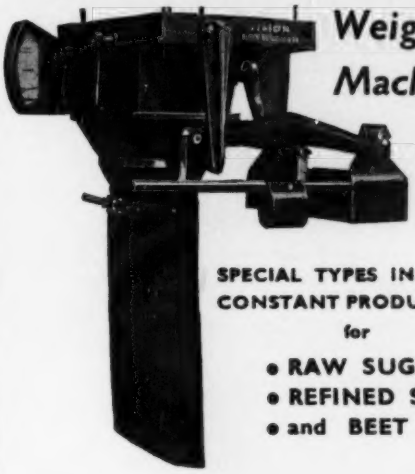

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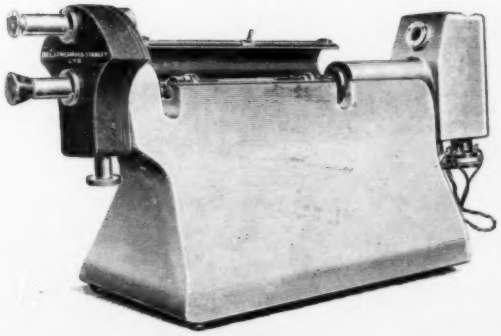

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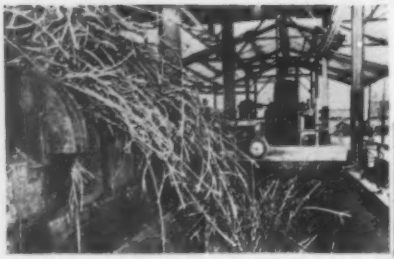

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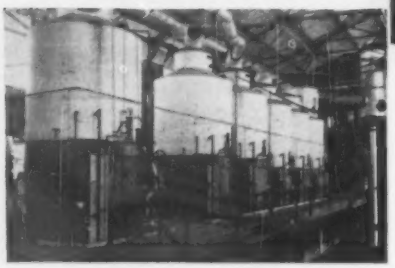

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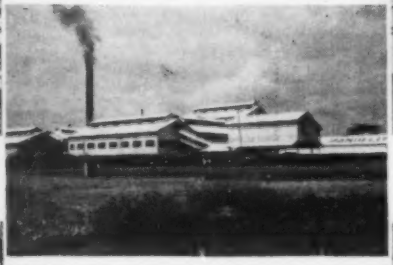

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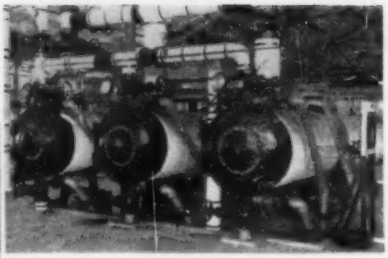

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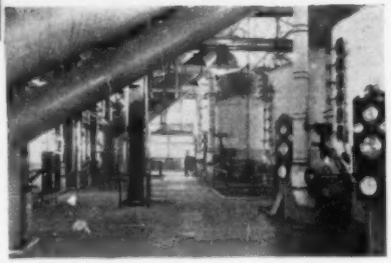

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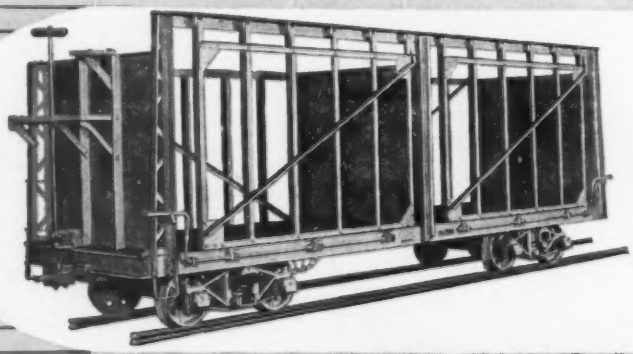

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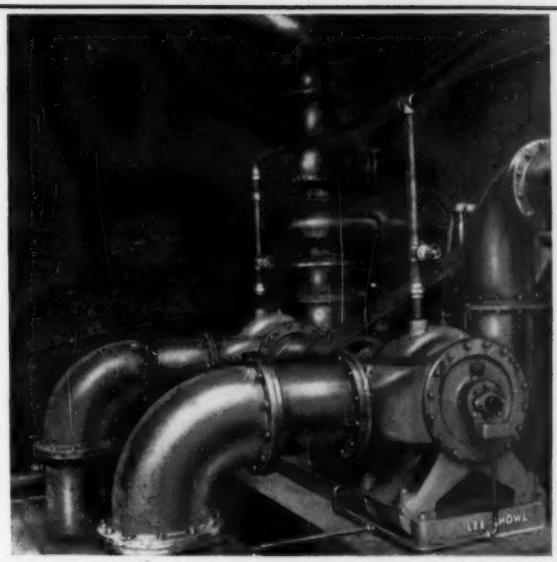

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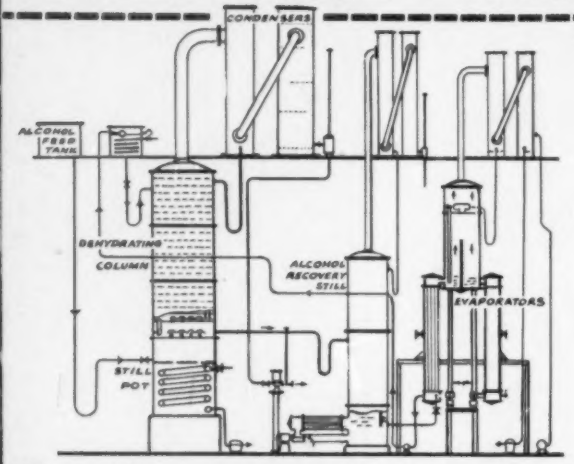

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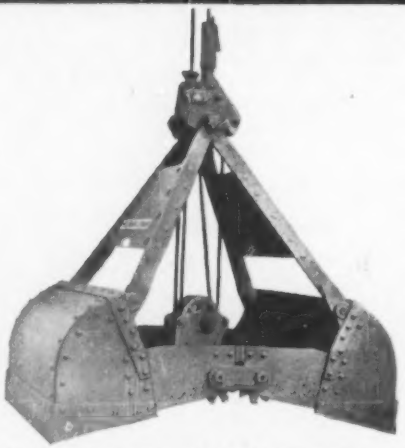

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1958 has been a year of healthy consolidation. The generally lower level of new business we have had in common with most capital goods companies has given us a much needed opportunity to examine all our operations with the emphasis on sharpening efficiencies and stepping up the rate of our technological advance. In both, we have made substantial gains.

The sharpening of efficiencies is evidenced by a number of changes. Our manufacturing costs and delivery times are both noticeably better. A reorganization of our Research & Development group has resulted in a greater emphasis on basic research and a speeding up of development of new processes and equipment. This will ultimately include more and better manpower in both these areas. We have simplified routines, eliminated many nonessential operations and projects which seem to creep in during boom times. This allows us to proceed with less staff, but a more able and experienced one.

The current lag in new business has been much less noticeable overseas, and we have been concerned with a number of very large and significant projects abroad. Our subsidiaries have continued to progress and are contributing substantially to the financial balance of our consolidated effort.

PULP AND PAPER — A Canadian pulp producer will install a complete D-O Bleach Plant, and Bleach Washers will be utilized in expansion of an Indian groundwood mill. Late in the year Brownstock Washing and Recausticizing Systems, Deckers and hypochlorite preparation equipment were ordered for a new French mill. At a second French mill, a large Brownstock Washing System was put into operation in 1958.

Recausticizing Systems will be installed at two other new mills, one producing paper in India and the other linerboard in the western United States. Continued evidence of widespread acceptance of the American Disc Filter has been demonstrated by the number of orders entered for this efficient saveall. Also of interest were filters ordered for local manufacture from our Australian subsidiary and our Japanese representative.

FOOD PRODUCTS — In the citrus industry, Merco Centrifuges and Mercone Screening Centrifuges have been applied to the finish-processing of orange juice prior to concentration. Successful also has been application of the Centrifuge-Precoat Filter combination to apple juice processing.

Corn starch washing systems consisting of various combinations of centrifugal equipment were ordered for mills in the United States, Colombia, Holland and Mexico. And, as in so many previous years, the sale of RapiDorr Clarifiers and O-C Filters for cane sugar processing has contributed heavily to orders entered.

FLUOSOLIDS SYSTEMS — Applications of the FluoSolids system were broadened in 1958 to include heat treatment or drying of such materials as foundry sand, phosphate base food products and concentrated detergent and for carbon reactivation. Another new application will be partial roasting of sulfide concentrates at one of Canada's largest smelters.

Other FluoSolids projects now in the design stage or under construction are slag dryers for India and Alabama; pyrite roasters for Spain, South Africa and California; a coal dryer for a midwestern producer and two-stage arseno-pyrite roasters for installation in the gold fields of northern Canada. Now in operation or under construction around the free world are over 100 FluoSolids installations on such proven applications as sulfide ore roasting, coal and slag drying, and limestone and phosphate rock calcination.

COAL — Fine coal recovery and water clarification will be accomplished at Eastern and Australian cleaning plants in large Thickeners ordered within the past year. In a number of instances, an American Filter and ODS Pump will complete the fines recovery circuit.

IRON AND STEEL — Proof of the versatility of the DSM Screen is its application at three points in the heavy media cyclone flowsheet. In its first use on the Iron Range it has considerably reduced magnetite losses. In this general field also, the Thickener-Filter combination has continued to be widely applied to recovery of blast furnace flue dust.

CHEMICAL—In 1958 new developments highlighted Dorr-Oliver activity in the far-flung chemical industry. Among the foremost of these was the plastic Filter, a rotary drum vacuum unit constructed of plastic with glass fiber reinforcing. Initial orders indicate the applicability and economy of this unit for mildly corrosive applications.

A second major development, the Merco H-30 Centrifuge, provides the chemical industry with a high capacity, high speed unit capable of clarifying up to 600 gallons of slurry per minute. The product of nearly four years of testing, this machine has substantially reduced operating power requirements per gallon of feed. One of the first commercial applications will be crystal separation at 90° below zero.

Result of yet another new design program is the expanded line of Type L centrifugal pumps. Here, three new designs provide increased capacity and head range and reverse inlet flow for operating speeds of both 1750 and 3500 rpm. In addition, Hypalon elastomer lining is now standard for both Olivite and ODS Pumps.

During the year a German manufacturer ordered the eighth and ninth Horizontal Filters for dewatering artificial resins, and domestic producers purchased Horizontals for such applications as washing ammonium sulfate and nitrocellulose and filtering potash and copperas. Also in the potash field was use of the DSM Screen for debrining crystallizer underflow.

GENERAL METALLURGICAL — Development of an air-lift agitation system for the American Filter has provided a third method of maintaining heavy solids in suspension prior to filtration. Complementing the conventional paddle and swing agitators, this new method has been extensively tested at operating installations.

U. S. and Chilean producers have ordered giant Thickeners with the strongest turntables ever fabricated, and a copper mill in the Belgian Congo will utilize ten large vacuum Filters in a current expansion. New construction at U. S. cement plants includes the three largest Slurry Mixers ever furnished, each 120 feet in diameter, as well as a variety of smaller machines.

WATER — Here also new construction and plant expansions resulted in application of a variety of D-O pre-treatment equipment. Two large Hydro-Treator mechanisms will supplement four additional units already in operation at Miami, Florida, and Topeka, Kansas will utilize Presedimentation Clarifiers and Flocculators. PeriFilter systems will be installed at Peoria, Illinois and Leander, Texas, and in Mexico City the first PeriFilter of a new, simplified control design is now going into operation.

Not the least of our gains in efficiency has resulted from new and vastly improved headquarters facilities both here and abroad. Our new International Headquarters was completed here in Stamford in July, the staff of D-O NV expects to move into its own new office building in Amsterdam shortly, and our associates in both Brussels and Paris are enjoying new and excellent facilities in co-operatively owned buildings.

In every respect, we are better prepared than ever before to take advantage of the upswing to come and to give better service to our customers throughout the world. This betterment, of course, could only have come about by the diligent and co-operative efforts of our total staff, and to them belongs the credit for the work done.

J. D. Hitch, Jr.
President

November 5, 1958

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